Municipal and County Engineering

DESIGN, CONSTRUCTION, OPERATION AND MAINTENANCE OF ALL PUBLIC WORKS

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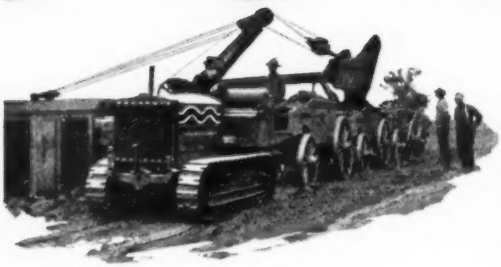

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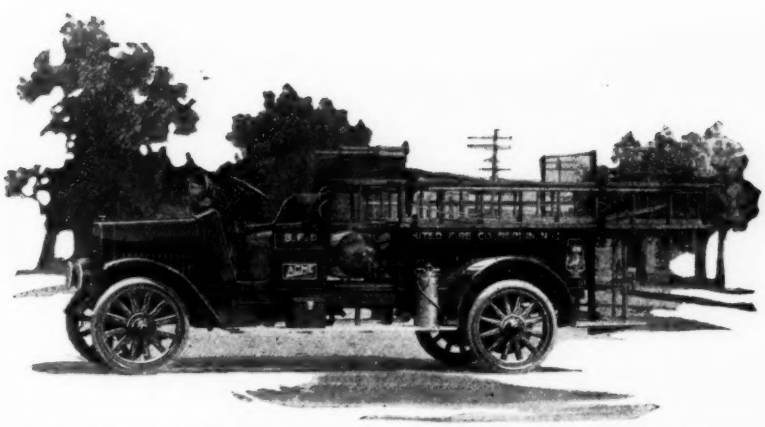
MOTOR TRUCKS

Motor Trucks as Operated in Municipal and County Service and in Highway Transportation



ACME COMBINATION HOSE AND CHEMICAL FIRE TRUCK OF THE BERLIN, N. J., FIRE DEPARTMENT

Motor Truck Operation and Accounting—72

THE MOTOR TRUCK NEEDS THE NATION'S GOOD WILL

By M. L. Pulcher, Vice-President and General Manager, The Federal Motor Truck Co., Detroit, Mich.

Everyone who buys something from someone else is served today by motor truck transportation. You cannot name an article of food, clothing, comfort, or amusement of yours, which has not, somewhere in its process of production, been hauled over the highways by gasoline propelled commercial cars. Indeed, from the first to the last stage of transit to the ultimate consumer, goods are usually hauled many times by truck.

Many people, quite thoughtlessly, seeing a truck lumbering along the road, say aloud or to themselves, "Why don't they keep those big trucks off our roads? They block traffic when we are in a hurry, and they spoil our roads for passenger travel."

Those same people are most impatient if the ice cream is late for dinner, and totally out of sorts if their trunk does not arrive at the shore hotel so that they can dress for dinner, or real put out if non-arrival of materials delays the completion of their home or factory, or entirely disgusted if their garage man doesn't get the parts or tires for their car in double-quick time. All of these commodities and thousands more are absolutely dependent on the motor truck as their delivery method.

The real facts are, the motor trucks are just as important to our well being as the passenger cars or railroads, and everybody employs trucks to haul for them directly or through their merchants. Just block all the roads that lead to you and me for one week, and see all that will be missed and mourned.

If this be true, then should not each one of us, every individual benefitting, help to build and maintain the highways over which our own personal things must be trucked?

Further, if they help our bodily health and comfort, should the trucks be forced off the highways by excessive fees and taxes?

The National Highway Traffic Association, in a meeting in Detroit recently, took the decided stand that the cost of highway construction should be paid by general taxation, and that maintenance cost should be pro-rated among users of the roads as such.

But they also said, and rightly, that the cost of maintenance should not be assessed against a type of vehicle for which the highway is inadequate. The next time you come to a highway look at it through new eyes. See it with critical, yet far visioning, glasses. See in it a great ever-growing channel of commerce. See it as an artery of lifeblood in the form of food for thousands.

Who built this road? Who is maintaining it, and will it withstand all of the transportation that must pass over it for the good of the nation?

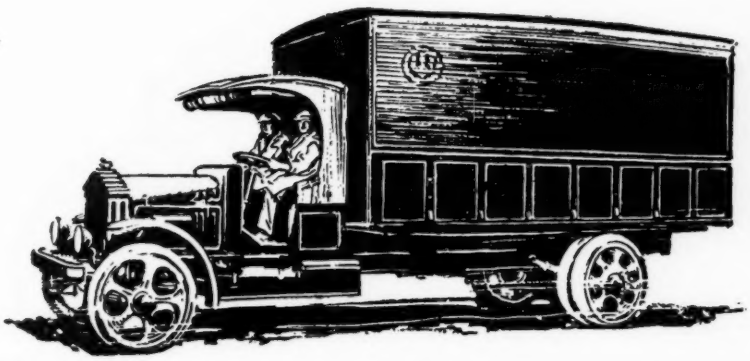
Should the men who transport the goods for you and others over it pay all the cost of building and maintaining it? If so, how much does that increase the cost of the goods to us, or should general taxation maintain this road for general use? And should every truck man that has a great, big truck have to stay off this road and let the goods spoil because the road is too pitifully weak to carry him? Or should the state and nation in which this road lies assess this truck man so much to carry your goods over this road that he has to let his expensive truck lie idle because he knows you won't pay the price which this necessitates?

Why not be reasonable and give motor truck transportation, so vital to every one of us, a sporting chance? Let's let the truck owner do his work without so many laws and fees, and in return ask him to be honest and fair in load and speed. The nation needs the motor truck, and the motor truck needs the nation's good will.

Have a Thought for the Road

Motor truck operators must have a constant thought for the road and its traffic limits in order to avoid further anti-truck legislation.

One of the largest office buildings in the world was recently erected in Detroit. An immense amount of yardage of earth had to be removed quickly. Result: contractors insisted on every truck hauling an overload. Three and one-half ton trucks carried 5 or 6 tons. Five and 6 ton trucks were forced to load to 8 and 10 tons. Result, the absolute destruction of about 20



What is a high price?

A truck that outlasts other trucks and costs less to operate is not high priced. Cost must always be figured against the work done and the time that is saved. The first cost of a Pierce-Arrow is no more than any good truck costs.

Pierce-Arrows not only do more work at a lower operating expense, but they keep out of the repair shop and keep working. And they last longer. It is the cheapest truck to buy.

Pierce Arrow

Delivers more work
Loses less time
Lasts longer and
Depreciates less
Costs less to operate

THE PIERCE-ARROW MOTOR CAR COMPANY, BUFFALO, N. Y.

blocks of heretofore adequate pavement on one street. No truck on this job was sufficiently tired for the loads they carried. So the pavement was pounded into debris in a few weeks. Result, a more drastic ordinance, but surprisingly fair in view of the destruction caused by the penurious contractors who were willing to spend the public's money for new roads and the truck owner's money for repairs to put a few dollars in their own pockets.

This story has been duplicated many, many times all over the country. The truck owner is not always wholly to blame, although he is in the end responsible.

The comparatively few trucks on such jobs create a sentiment against all reasonable truck owners, and with city fathers, legislators and congressmen so anxious to find objects of regulation—the result is oftentimes unreasonable and frequently ruinous legislation against the motor truck.

It is time to be more thoughtful and less greedy. The commerce of the nation absolutely depends on motor truck transportation. Roads and bridges, happily, are being properly built and strengthened to carry the loads which good business demands of highway transportation. But it is high time for abuses to stop. Arrived is the moment to have some regard for our neighbors. There are other men, women and children depending on motor haulage for their living besides you and yours. There are little ones by the thousand who must have milk. If you dig a hole in the pavement or highway with your overload—some one may demand that all trucks the size of yours be kept off the road. That may stop the milk supply or the fresh vegetables, or the coal or any one of a hundred other necessities that we must have continuously delivered.

Have a thought for the road. Remember your neighbor. Be fair—be reasonable, so that trucks will be fairly treated on the statute and tax books.

MOTOR TRUCK NEWS NOTES

Trucks Favored by Live Stock Raisers

A. F. Stryker, secretary and traffic manager of the Omaha Live Stock Exchange, in testifying at the freight rate hearing on live stock before the Interstate Commerce Commission in Chicago during the week of June 13th, stated: "The high freight rates are forcing live stock producers to ship by truck; 20 per cent of the hogs in one day's receipts at Omaha were delivered by truck. On Monday, June 6th, 50 per cent of the sheep received at the St. Joseph market came by truck."

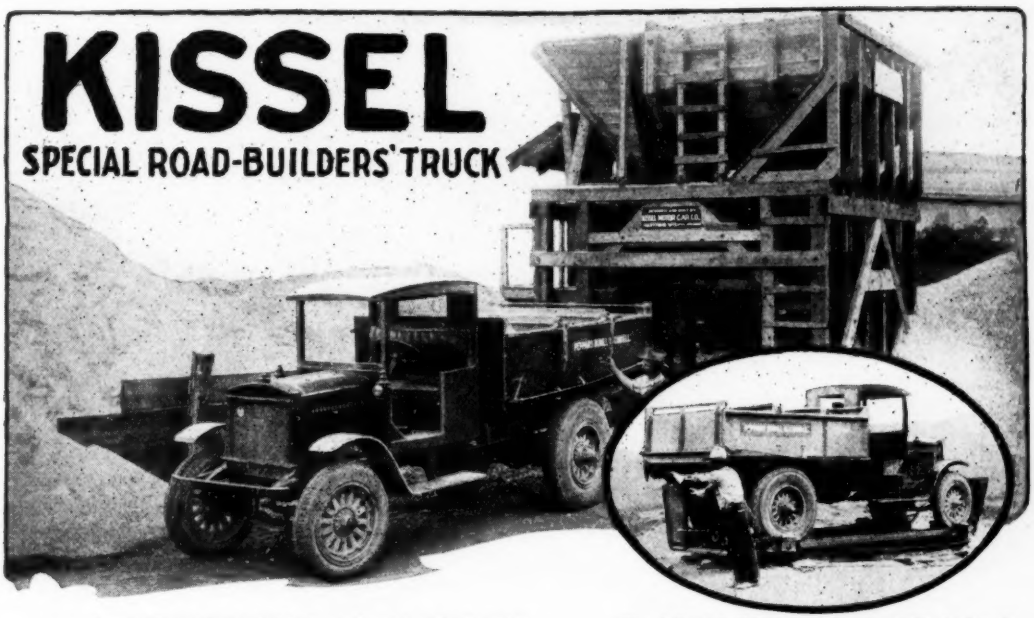
It is estimated that more than 3,000,000 head of cattle, hogs and sheep will be transported by motor truck direct from "farm to yards" during 1921, this being based on 1920 figures from 17 stock yards in the corn belt.

It is predicted that if it were possible to get the actual figures covering the number of head transported by truck from farm to rail siding and then by rail to stock yards, as well as the number of head arriving by motor truck at the dozen of smaller stock yards where no record is kept on stock arriving in this manner, the grand total for 1921 conservatively estimated, would surely reach 6,000,000.

In commenting on this conclusive evidence of the adaptability and dependability of the motor truck for raisers of live-stock, Harry P. Branstetter, Chicago Kissel distributor, states, "The use of the motor truck in transporting live-stock has a number of economical advantages, such as being the quickest and the cheapest method of delivery, because it prevents shrinkage to a large degree. This is especially important in farm to railroad siding to yards delivery because a freight car may not be spotted for several days after it is ordered—consequently the producer can keep his stock on his farm until a few hours before the car is set for loading. This ability of the motor truck for speedy delivery eliminates the necessity of stock waiting in the loading pens, which should always be avoided if possible.

"In the case of a direct 'farm to yards' haul the truck enables the producer to get his stock to the yards when the market price is highest. Also the stock can be shipped when it is in the best marketable condition instead of having to ship whenever the freight car arrives, irrespective of the condition of the stock.

"The live stock business of the country is dominated by four markets—Chicago, Kansas City, Omaha and St. Louis, and it is in these four centers that the use of the motor truck in the live stock business reaches its highest point. Some idea of the importance of these markets can be gained from the fact that live stock farmers receive an average of nearly $6,000,000 every business day in the year for live-stock marketed at these four centers."



Special Kissel Road-builder's truck ready to back under Kissel Combination Hopper that dumps three batches of correctly measured sand and gravel by one trip of lever in less than three seconds.

Kissel Road-builder's truck on specially designed turntable, turning loaded truck around in less than ten seconds—saving time, labor and depreciation on truck.

Kissel Engineering Efficiency enables Peppard, Burill & Connell, prominent Minneapolis contractors, to establish increased road-building efficiency

TIME CONSUMED IN OPERATING KISSEL TRUCKS AND EQUIPMENT

(Johnson Creek, Wisconsin, Road Contract)

Loading, raising and emptying 1¼ cu. yd. clam into bin	35 seconds
Charging 9 measuring boxes (6 boxes of 18 cu. ft. gravel; 3 boxes 10 cu. ft. sand)	12 seconds
Locking truck partitions—backing under hopper—receiving load and starting on trip averages	25 seconds
Discharging 9 measuring boxes into truck	2 seconds
Speed of Kissel truck—loaded with 3 batches	25 M.P.H.
Speed of Kissel truck—unloaded	30 M.P.H.
Turning loaded truck on turntable	10 seconds
Backing to mixer, dumping 3 batches into skip end and starting on return trip	4 minutes

To build about five miles of concrete road—18 feet wide—connecting Watertown with Johnson Creek, Wisconsin, in about two months (started July 6th, up to August 8th reached half-way mark), Peppard, Burill & Connell employed the following Kissel road-building equipment:

1—Kissel designed and built combination hopper and measuring box.

2—Nine special Kissel Road-builder's trucks of 3-yard capacity each (averaging about six trucks for entire contract).

3—Special designed turntable for turning loaded trucks.

4—Proper supervision.

How this work was carried out and systematized by the Kissel road division, enabling Peppard, Burill & Connell to establish increased ***road-building*** efficiency, such as laying 855 feet of concrete road on July 29th, is told in a specially illustrated folder showing each step from hopper to mixer, which we will forward to reputable contractors and road builders.

In addition we have in preparation engineering data from different Kissel engineered and equipped road-building jobs—showing actual cost per batch on various length and graded hauls. Address

KISSEL MOTOR CAR COMPANY
HARTFORD, WIS., U. S. A.

Truck Ownership

"I recently had an entirely new aspect of motor truck utility presented to me," says H. P. Branstetter, Chicago Kissel distributor.

"The successful concern of today, whether a large corporation dealing in millions or a one man outfit dealing in hundreds, prefers to own its equipment and facilities. It doesn't rent its factory, store, office or farm. Much less does it rent equipment in continual use, such as typewriters or machinery. Such a policy would be uneconomical, because renting implies payment of profit to the owner of the thing rented, a profit paid by the user. It does not pay to rent any facilitity that is in use continually.

"Every business, every farm, is continually using short haul transportation, that is, transportation under one hundred miles. Why not own the facilities for your transportation rather than rent them, or hire them from the railroad, especially when the modern facility, the motor truck, is much more economical and vastly superior to the rented facility for hauls under one hundred miles? In addition, ownership implies complete control, the rendering of service particularly adaptable to the business, impossible of rendition by public service companies."

Factors Influencing the Truck Buyer

"Trucks are not bought according to price alone," says Harry P. Branstetter, Chicago Kissel distributor.

"Many other factors are considered by the motor truck buyer of today. The truck must be of right size and capacity to fit the individual requirement for only then will the following advantages result:

"Lowest cost per mile, low gasoline and oil consumption, minimum wear on tires, maximum power at the lowest expense, most efficient operation of all fixed or moving units, minimized wear and depreciation, big saving in time and labor, elimination of breakage from overstrain, lowest service expense, small capital invested in parts stock.

"And for the same reason fleet owners today are standardizing their fleets of trucks, not necessarily all of one size but decidedly all of the same make.

"Buyers of trucks today are depending more and more on the helpful analysis of their needs by the dealers and salesmen of motor trucks. Trucks for long freight hauls have come to stay. Their position is unassailable.

Guarding Truck Fleets Against Robbery

Intercity motor haulage has now reached that stage of development where its possibilities are appreciated by all classes of people including highway robbers. Of course this menace exists only where the traffic is heavy and in such cases steps are being taken for the provision of a safeguarding constabulary. The following article on this topic is reprinted from a recent issue of "Greater New York," the official bulletin of the Merchants' Association of New York:

Highway robbery of merchandise shipped by truck between New York City and outside points has become so serious that a guard of deputy United States marshals has been organized to convoy shipments.

Brigandage on Philadelphia Route

The plan adopted was laid before the Board of Directors of the Merchants' Association with a request for co-operation on the part of the members of the Association. The immediate situation which brought about action was the condition that exists along the motor highway between New York and Philadelphia, where losses have become so great that the adoption of a protective plan was deemed imperative.

The only plan believed to be feasible was the adoption of some system of armed protection for trucks and cargoes and the elimination of collusion between drivers and thieves. To this end deputy United States marshals have been employed as guards to protect truck fleets.

Truck Fleets Guarded

There is a definite meeting place in Jersey City and another in Philadelphia where all trucks going in convoy assemble at a certain hour of the night. At these points they are met by the guards who remain with them until they arrive at their destination.

In order to keep the convoy together and to eliminate stragglers, a rule has been established that any truck that may become disabled shall be taken in tow by the other trucking convoy until it has been brought under the protection of the nearest organized police department.

Cuts Down Expenses

The cost of protection thus afforded is said to be small and it is expected that it will be still further reduced, if it receives the support of shippers.

Arrangements have been made with an insurance company to give reduced

When You Buy a Motor Truck

Select it with care for It makes a difference (*to you*)

what truck you buy. Your truck should be selected to suit the character of work you expect it to perform.

You would not think of buying a pump in the open market without first satisfying yourself that you are selecting the right type and size to handle your pumping job, and you should not buy a motor truck, at random, without giving careful consideration to the size, type and other features it should have to meet satisfactorily the conditions under which you expect to operate it.

There are over 200 makes of trucks on the market. Any truck manufacturer will take your order, of course, but only a small percentage of all truck manufacturers have made a special study of the trucking requirements of cities, counties, road builders and public works contractors.

These special studies have resulted in up to date, competent motor truck engineering which determines the proper size of truck and the proper truck equipment for solving the various hauling problems of cities, counties, contractors and road builders.

This magazine has published a special Motor Truck Section in every issue for **six years** and has studied carefully the trucking problems of this field and the trucks that best solve those problems.

If in the market for trucks let us know your requirements and we shall be pleased to give you the benefit of expert advice.

Municipal and County Engineering

702 Wulsin Building **Indianapolis, Indiana**

rates on convoyed merchandise so that, instead of an additional charge, there is actually a considerable saving on each trip.

The directors assume that any member of the Merchants' Association who desires to avail himself of this service will arrange his insurance through his own broker.

EFFECTS OF SOLID AND PNEUMATIC TRUCK TIRES ON THE SUBGRADE

To the Editor:

We have heard from several sources propaganda directed at state highway engineers and county commissioners in the endeavor to induce them to restrict trucks engaged in the construction of highways to the use of pneumatic tires. This agitation is ostensibly created on the basis that the penumatic tire will not damage the incompleted road surface or subgrade to the extent that will a solid or cushion tire.

Let us investigate the fact, however: Assuming a 7½ ton truck to be used, we will find the weight on the rear wheels, taking into consideration the distribution of load, weight of the body and the like, to be a total of approximately 17,000 lbs., or 8,500 lbs. on each wheel. The biggest pneumatic tire yet developed, and which has not as yet proved a commercial success, is the 48x12 in. size, the manufacturers of which allow at present a load capacity of just 8,500 lbs., provided this tire is inflated to an air pressure of 140 lbs. This means that the weight per square inch of road contact will be 140 lbs. and that the area of contact will be 61 sq. ins.

This same truck would doubtless be equipped with 14 in. cushion or solid tires which would have a capacity of 12,000 lbs., or 3,500 lbs. more per wheel than the pneumatic. Tests have also shown that the weight per inch of contact of solid-tired wheels is 105 lbs. as against 140 lbs. in the case of the pneumatic. We would, therefore, find that the area of contact of the non-resilient solid tire is practically 81 sq. ins. as compared with the 61 sq. ins. of the pneumatic.

Inasmuch as road damage, rutting and the like is entirely a factor of weight per square inch of road contact, it is easy to see that the properly-selected solid tire will in reality cause less road damage to a soft surface than will a properly-inflated pneumatic tire. If we consider the semi-solid or cushion type of tire in which the area of contact is considerably increased above that of the solid, we will find the ideal equipment for soft or uncompleted road surfaces.

This is an important matter and yet is one which has been too hastily investigated by many road commissioners. It is simply a question of elementary mathematics. Very truly yours,

H. W. Slauson.
Engineering Service Manager,
Kelly-Springfield Tire Co.

1710 Broadway, New York,
July 13, 1921.

(The foregoing letter commenting on a subject of great importance to highway engineers and contractors, motor truck and tire manufacturers, is published to draw out a discussion on the merits of solid and pneumatic truck tires on road construction work. Correspondence is invited from all interested firms and individuals and letters received for publication will appear in the September issue of this magazine.—Editor.)

ADVANTAGES OF OILING SUBGRADES BEFORE PAVING

To the Editor:

It is very evident, after studying the large number of earth roads which are being oiled in Illinois, that it is possible and economical to oil roads preparatory to construction. We oiled 1½ miles of road preparatory to the construction of some of our Frankfort day labor work. The road, however, had just been graded and the subgrade shaped, hence the oil was not as effective as it would have been had the road bed become compacted before the oil was applied. We also used three-ton trucks on the subgrade for the delivery of materials and it is generally admitted that trucks of this weight are too heavy for the average earth road. The road, therefore, was rutted about as badly as if no oil had been used.

Where it is possible to do all of the grading a few months in advance of the paving so that the subgrade will become thoroughly compacted, the oiling will undoubtedly be a success. This is especially true where pneumatic tired trucks are used for the hauling of materials. Thus far we have not been successful in getting a contractor to oil the subgrade where conditions of this kind exist.

In addition to the advantage of hauling materials over an oiled road bed there will be no sprinkling of the subgrade necessary preparatory to the laying of the pavement. The oiled earth road would prevent the earth from absorbing the moisture from the concrete. The oil will also have some advantage in that it will prevent capillary attraction of the subsoil moisture, thereby maintaining a drier subgrade beneath the pavement. In one or two cases we have oiled the subgrade before laying the pavement, but we have not had sufficient time to determine its full advantages. Very truly yours,

B. H. PIEPMEIER,
Engineer of Construction, Illinois
Division of Highways.

Springfield, Ill., July 18, 1921.

HIGHWAYS ENTERING LARGER PENNSYLVANIA CITIES WILL BE WIDENED

While no immediate construction activities will result, the State Highway Department of Pennsylvania for the last two years has been making a study of traffic conditions on thoroughfares leading to important municipalities of Pennsylvania and eventually steps will be taken to increase the width of the arteries leading into the larger cities of the state.

It is apparent that with the normal increase in the registration of motor vehicles the present width of highways will be entirely inadequate within a few years. At the instance of the State Highway Department the 1921 legislature gave consideration to this matter and enacted legislation which received the approval of the Governor and which will give the State Highway Department power to extend the width of important thoroughfares so that they will be adequate for the safety of road users.

It is not the purpose of the State Highway Department immediately to widen these highways, but merely to make a survey of possible future traffic so that lines may be laid down for the guidance of individuals or others who are contemplating improvements along these routes. The proceeding is similar to that followed by municipalities which establish building lines along undeveloped streets.

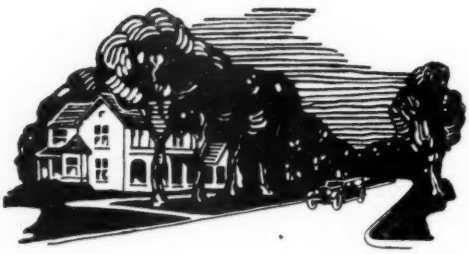
The State Highway Department hopes by this procedure to save the enormous expenditure which will necessarily be entailed in widening arterial roadways after improvements have been completed. To this end it is working in conjunction with the Suburban Association of the Main Line, whose membership is composed of students of the highway problem in Philadelphia and the adjacent counties of Delaware, Montgomery and Bucks.

Commissioner Sadler and the engineering forces of the department are looking ahead 15 and 20 years to the traffic which will then be using the roads of Pennsylvania. The recent legislature gave the department authority to extend the width of highways to 120 feet. That a number of arterial thoroughfares will be extended to that width eventually is a certainty. If this were postponed and owners of adjoining property had made improvements, the cost would be extraordinarily high, as was the cost of opening the parkway in Philadelphia several years ago. Commissioner Sadler believes that by setting the lines now property owners, if they build, will build back of those lines.

The great increase in motor vehicle traffic within the limits of the larger municipalities of Pennsylvania will eventually necessitate the building of thoroughfares skirting these municipalities and wide enough to accommodate several streams of traffic going in both directions. Within a few years it will be unwise to send heavy trans-Pennsylvania traffic into Philadelphia and Pittsburgh, for example, inasmuch as addition of this traffic will add to the congestion of the down-town districts. Consequently wide roads must be provided around the larger cities so that traffic may be accommodated.

CALIFORNIA TAXPAYERS MUST PAY FOR CAR TRACK PAVING

It is reported that a number of southern California cities are rushing delayed street paving projects in anticipation of the law which will relieve street railway companies from the obligation now imposed upon them to pave their rights of way. This legislation was enacted at the recent session of the California legislature and has been approved by Governor Stephens. Street paving has been a heavy burden on the railway companies and they contended that inasmuch as the bus lines were permitted to use the streets in competition with them without sharing any responsibility for paving, the railway companies should, in all fairness, be relieved of the burden. In the future property owners will be required to pave the entire width of streets on which railway tracks are laid.



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Write for Street Booklet R-4

EDITORIALS

RUBBER ROAD ROLLERS

A suggestion that road rollers be made of rubber would be greeted with derision. Probably everybody would agree that rubber lacks every property a material fitted for use in the manufacture of road rollers should possess, including durability, hardness, weight, cheapness, etc. Notwithstanding all this, in many localities rubber road rollers are being used. True, they are not called by that name, although they are forced to attempt the service for which rollers are made and provided. These rubber rollers are commonly known as automobile tirse.

When all vehicles were horse-drawn and iron-tired it was a common practice to spread loose gravel or stone on the road surface and to depend on the grinding and rolling action of the iron tires and the tamping action of the horses' feet gradually to level off and solidify the surfacing material. This was, perhaps, all well enough for its time and place. There may be, and probably are, still many roads used almost exclusively by the old type of traffic described, and on such roads the old method may still be employed where funds are low and the need for some sort of road surfacing is urgent. But the method becomes an extreme case of the survival of the unfit when employed on roads carrying a heavy, modern, rubber-tired motor traffic.

In the first place, the modern type of traffic is inferior to the older type, for the purpose under discussion, as the rubber tires are decidedly less efficient than iron tires in their crushing and rolling action. Then, too, with motor traffic the entire contact with the road, such as it is, is confined to narrow wheel tracks or ruts; there is nothing left to perform the tamping action of the horses' feet, which gradually compressed all the loose material between the wheel tracks. Thus, from the standpoint of efficiency, the rubber-tired motor vehicle is not well suited to this obsolescent type of road construction.

In the second place, it is a very uneconomic practice to attempt to compact comparatively inexpensive loose road material with expensive rubber tires. There probably are limits within which this practice is defensible, but it is certain there are limits outside of which the practice is indefensible. Occasionally the motorist runs into miles of coarse, crushed limestone, loosely spread over the road, and is forced to drive his car over it, although he knows that the sharp corners of the stone are cutting his tires with every turn of the wheel. This is, indeed, very poor economy.

Where gravel is used, consisting of round pebbles and sand grains, the damage to rubber tires is much less than in the case of crushed stone in large sizes, and, of course, if stone screenings are spread over the crushed stone this also serves to protect the tires. It is for this reason we say that there may be limits within which the practice is permissible from the standpoint of good engineering, and we hope that technicians will establish these limits and make them known to local road-building authorities.

We are very sure that the practice of spreading out coarse, crushed stone over the road surface, without the saving presence of fine-grained material, is deserving of total condemnation and should be made illegal.

OUR UNDEVELOPED CITIES

It is customary to assume that our cities are well improved with water works, sewers, pavements, street lights, bridges, etc. As a matter of fact, our cities are very imperfectly developed with these and similar improvements.

Take an important secondary city, of some hundreds of thousands of population, of great industries and great wealth, as an example. The public water supply is of excellent quality from the bacteriological standpoint, but not up to desirable physical standards, possessing properties, as delivered, which require household treatment to make it satisfactory for domestic use. Some surface wells are still in use within two miles of the city hall.

The politest assumption of all is that our cities are well sewered. In the city selected as an example many houses are not connected to the public sewers. On some premises may still be seen that type of structure which told "the night-o'er-taken tramp that human life was near." Other houses are sewered, but discharge into natural water courses which flow through public parks and playgrounds. The surroundings of these water courses, with respect to planting and seeding, are as beautiful as one could wish, but the

water in the streams is obviously defiled by household and trade wastes.

Many streets, otherwise fully developed, are not paved at all. Many existing pavements are in such poor condition that a good dirt road would be preferable to them.

The bridges are of excellent design, both from the utilitarian and aesthetic standpoints, but the bridge floors, as a rule, are not in good repair, many being difficult, if not dangerous, to drive over.

Railway tracks are elevated in some places, but elsewhere grade crossings are still in use, many of them unprotected, and they are rougher, on the average, than railway grade crossings on country roads.

The city is exceptionally fortunate in having many fine trees along its streets. This should call for exceptional street lighting facilities, but the street lights are dim and widely separated.

Other deficiencies might be enumerated, but enough have been mentioned to illustrate the point, namely: even our large cities are in need of intensive development with respect to public improvements to bring them up to the standards wealthy and progressive communities set for themselves. There are many loose ends to be gathered up which city boosters would do well to consider.

ENGINEERS' VIEW OF FALL CONTRACT AWARDS

Contractors favor awarding road construction contracts in September and October, and a movement is on foot, sponsored by contractors, to change the custom, now in vogue, of letting contracts in the spring. The reasons underlying this suggested change are well understood and were stated in an article published in our July issue.

In this issue we publish letters from many of the state highway engineers, in the Northern states, commenting on the merits of fall awards.

The reader will find the letters of live interest and it is our purpose, here, merely to call attention to them. It will be noted that the engineers are not in full agreement, thus demonstrating, at once, the value and need of this discussion.

Other things being equal, everybody would favor the fall awards, but other things, it seems, are seldom equal—but the letters tell the story in full.

One point only, made by the engineers, is selected for emphasis here: If contractors expect to change the present scheme they must make good when they have opportunity. On some contracts, awarded in the fall, the successful contractors have loafed all winter, doing nothing at all, apparently, before the regulation time in the spring. They cannot expect to reshape matters by following that line of inaction.

THE RAILWAYS ARE "COMING BACK"

Readers will appreciate the article in this number on the railway situation: past, present and future. It holds forth much encouragement to believe that the railways are gradually "coming back."

There are numerous evidences of a return of the old railroad spirit. For one thing, excursions are being featured again.

The old esprit de corps is again in evidence, also; the old zip and dash on the part of the men who run the trains. May we present an example of this?

Some months ago a notorious gunman in a large city, with a long record of homicides to his discredit, was apprehended by five policemen, and, in the business of escaping, shot one of the policemen. Never happy in the selection of his victims, he was particularly unhappy in this case, and the entire police force of the great city determined to recapture him. The co-operation of the police of other cities was secured in searching for him, but for many months he evaded arrest.

Not long ago, it is reported, he boarded a passenger train as it was pulling into the yards, and, drawing one of his three loaded revolvers, confronted the porter. The porter was unarmed, but did not hesitate to take a gun from the bad man, call for help, and swing a mean left to the gunman's jaw. The fugitive jumped from the train and tried to scramble aboard a locomotive standing on the next track. The engineer kicked him deftly in the face and knocked him down. The engineer's name is not reported. We suspect it is Casey Jones. It seems he had never heard of the gunman.

Then the bad man started running, and the conductor, yes, even the conductor, started to chase him, caught him, threw him and sat on his stomach until the police arrived.

The railways are coming back.

STATE HIGHWAY ENGINEERS COMMENT ON PROSPOSAL TO AWARD CONTRACTS IN FALL

The statement of the case favoring the awarding of highway contracts in September and October, instead of in the spring, was very well presented in the July issue of MUNICIPAL AND COUNTY ENGINEERING. The editor asked several state highway engineers to express their opinions on the merits of this proposal, as fostered by the Associated General Contractors and other business interests, and we publish their letters herewith. We shall be glad to publish letters of comment on the points here made by the engineers:

Colorado

Mr. L. D. Blauvelt, State Highway Engineer, Denver, Colo., writes:

"I am certainly in sympathy with the plan of letting contracts in the fall of the year, in order that preliminary steps may be taken and the work gotten under way early in the spring, with the chance of completing same during the summer season."

Idaho

Mr. D. P. Olson, Director Bureau of Highways, Boise, Idaho, writes:

"In practically all sections of the state it would be advantageous to the contractors as well as to the department to award the contracts in the fall. However, there are other portions of the state in which this would be practically impossible, but taking the state as a whole it is the opinion of the department that the awarding of contracts should be made in the fall instead of the spring.

"I do not believe it necessary that I should go into the arguments relative to the decision of the department in this matter, as the conditions surrounding the same are too well known to require any lengthy discussion on our part."

Illinois

Mr. Clifford Older, Chief Highway Engineer, Springfield, Ill., writes:

"In my judgment the best policy as to the time for awarding contracts on a large scale varies from year to year, depending upon general conditions.

"I am speaking, of course, from the point of view of the owner or builder. Ordinarily the contractor, who has perhaps 50 per cent. or more of the road equipment needed for a given job, is able to secure the balance of the equipment and be ready to start work in approximately 60 days. This would indicate that in this latitude and as far as the contractor's ability to start work at the beginning of the season is concerned, the award of contracts in February or March would be satisfactory.

"Such an arrangement, however, would not, of course, enable equipment manufacturers to forecast very definitely the demand for the next season's construction, and they would be obliged to use less definite data in anticipating the demand for manufacturing equipment during the winter months. The advantage of the earlier knowledge of the demand for equipment might easily be offset by labor and material conditions, which cannot definitely be foreseen six months in advance.

"From the point of view of the state, therefore, it is my opinion that the awarding of contracts in the fall in preference to the spring must largely be based on an estimate of labor and material conditions which may prevail during the early part of the succeeding construction season."

Indiana

Mr. G. R. Hass, Office Engineer, Indiana State Highway Commission, Indianapolis, writes:

"It is now the policy of the Commission not to let any contracts for road surfacing until after the first of the next year. It is, however, our policy to let contracts for grading and structures this fall on projects that require heavy grading so that they may have the winter in which to become compacted, and so we may let surfacing contracts on them next year.

"I cannot give, as an opinion of the department, a statement regarding whether our Commission approves awarding contracts in September and October, instead of the spring months, but do feel that wherever we have heavy grading on a contract that it should be let at such a time as will least interfere with traffic and also will get the subgrade prepared for a period previous to paving, so that it will become thoroughly compacted and not settle or shrink after the pavement has been laid."

Iowa

Mr. F. R. White, Chief Engineer, Ames, Iowa, writes: "We believe it to be a good policy to let highway contracts in the fall for construction the following spring, rather than waiting until spring to let the contracts. Of course it is not always possible to follow out this policy, due to the fact that it may be impossible to get the surveys made and the plans prepared and

other necessary preliminaries taken care of in time to let contracts in the fall."

Kansas

Mr. M. W. Watson, State Highway Engineer, Topeka, Kans., writes:

"I can see considerable merit in awarding contracts in September and October if the contractors proceed to make their necessary arrangements for early spring construction as soon as the contract is awarded. It is especially desirable in this state in view of the fact that a considerable portion of the earthwork and culverts can be completed before spring, giving the contractor more freedom in the handling of his pavement work.

"We have found, however, in a number of instances in this state that it made very little difference in the results produced. The contractors simply felt that they had such a long time to prepare for the spring work that they put it off until time to start construction just as if the contract had been advertised and let during the latter part of winter and early spring. The matter depends upon the attitude taken by the contractor after the contract is awarded."

Kentucky

Mr. Joe S. Boggs, State Highway Engineer, Frankfort, Kentucky, writes:

"I am not in sympathy with the movement being fostered by the Associated General Contractors and other business interests to have all highway contracts awarded in September and October instead of the spring months. On account of the volume of work now being handled by the various highway departments of the country it is impossible to concentrate the awarding of contracts to such a short period of time in the year."

Maine

Mr. Paul D. Sargent, Chief Engineer, Augusta, Maine, writes:

"If labor and material conditions were stabilized I should be very much in favor of letting contracts during the fall months for work to be executed during the following season. Under present conditions I do not believe that method will return to the states full value, on account of the fact that labor prices and material prices are declining constantly and there is apt to be considerable difference in the cost of these two items between September or October of one year and April or May of the next.

"We have tried this method on two or three good sized contracts and we have not received results which we expected. In the fall of 1919 we let two big contracts, and as far as I am aware no preparation was made by the contractors during the winter and neither contract was completed in 1920, and neither one is completed yet, although the prospects are that they will both be finished by the first of the coming September. These contracts were bid substantially on the peak of the labor market and labor has declined here from 35 to 40 per cent since those contracts were let."

Maryland

Mr. John N. Mackall, chairman and Chief Engineer, Baltimore, Md., writes:

"I don't believe any general good will result from the awarding of contracts in the fall instead of in the spring. In fact, I think that every day the awarding of contracts is delayed brings down the price. If the contractor has work in the fall for the next year he is not interested in cutting wages, but if when the spring comes he has no work he is decidedly interested in cutting wages; and really the cutting of wages is the key to the high cost of road construction."

Massachusetts

Mr. A. W. Dean, Chief Engineer, Boston, Mass., writes:

"When we are having continuous normal conditions in labor and material prices I consider that it is good business to let as many contracts as possible in the months of November and December, so that work may commence very early in the following spring.

"I do not consider it good business, however, to let contracts in September or October and permit contractors to do any work during the fall months that would interfere with the use of the road during the winter months.

"It was not good business to let contracts in November, 1920, for work to be done in 1921, as the prices of labor and materials were very much less in 1921 than they were in 1920. It is for this reason that I qualified my first statement as to 'continuous normal conditions.'"

Michigan

Mr. Frank F. Rogers, State Highway Commissioner, Lansing, Mich., writes:

"In regard to the awarding of contracts in the fall for the following year's construction: It is my opinion that if conditions are normal this would certainly be a proper thing. However, no one has been able to predict during the past few years, or at least since previous to entering the World War, what the conditions would be the following year. We would certainly not care to let contracts under uncertain

conditions, as while it might be very fortunate for the contractor to take a contract and then reap the benefit of a declining market, it would be just as disastrous for him to take a contract and then suffer because of a rising market. It does not appear that there would be any particular advantage for certain types of construction such as so-called low type roads, but there is no question but what there would be advantage for pavement work, as it would allow the contractors to get all of their equipment and a large stock of materials on the ground.

"This department is not in a position this year to let contracts so far in advance. However, it is expected that contracts will be let early in 1922."

Minnesota

Mr. John H. Mullen, Chief Engineer, St. Paul, Minn., writes:

"On a number of our projects we found that the businesslike way to handle this was to let contracts in the fall so that material and equipment may be delivered and in readiness for work in the spring. In some cases this has been taken care of by the state purchasing equipment and stock piled, but that is not always satisfactory, for the reason that it is difficult to anticipate the layout for contractors' organization. We have no fixed policy in regard to fall letting of contracts, the determination being made on the merits of each individual case."

Missouri

Mr. Alexander W. Graham, State Highway Engineer, Jefferson City, Mo., writes:

"I think this plan of awarding highway contracts in September and October instead of the spring months a very good one indeed, and if it were possible for us to do so I would be glad to see our contracts advertised for letting during the above mentioned months, but so far we have had to let our work as rapidly as we could get it ready. However, in the future some such plan as mentioned in your letter might be adopted by this department."

Montana

John N. Edy, Chief Engineer, Helena, Mont., writes:

"This Commission is fully in sympathy with the movement fostered by the Associated General Contractors, to secure the award of contracts in the fall instead of the spring, but it is not always possible for us to arrange our program accordingly. We propose to continue the awarding of contracts throughout the fall and winter, whenever it is possible, thereby permitting the contractors to secure their materials and make their other arrangements so as to begin the construction work as early in the spring as feasible."

Nebraska

Mr. George K. Leonard, Assistant Secretary, Department of Public Works, Lincoln, Nebraska, writes:

"We agree with the contractors when they say that from their standpoint it is desirable to let contracts in the fall. Without doubt this gives them a chance to organize their work for the coming spring and at the same time permits the engineer to dispose of some of the preliminary work.

"From the engineer's standpoint, however, we feel that this method of letting contracts would have a tendency to keep prices up. We feel that the competition would not be as keen in the fall as it is in the spring, when all contractors are anxious to sign up for their season's work.

"For these reasons this Department will not award any highway contracts in the fall."

Nevada

Mr. C. C. Cottrell, State Highway Engineer, Carson City, Nevada, writes:

"We are in thorough accord with the awarding of contracts during the late fall and winter months. However, there are matters governing this such as financing, which unfortunately cannot be arranged until it is possible to do the work. We are doing everything in our power to assist in this matter."

New Hampshire

Mr. F. H. Colburn, Assistant State Engineer, Concord, New Hampshire, writes:

"Regarding the desirability of awarding highway contracts in September and October instead of the spring months: This plan is without doubt an excellent one, but I feel that it is impracticable in some of the northern states, such as New Hampshire, as our highway funds are available for two-year periods only, and it is impossible to forecast what legislative action may be taken. Contracts could not be awarded in the fall hinging on a doubtful appropriation during the following winter."

New York

Mr. Herbert S. Sisson, Commissioner of Highways, Albany, N. Y., writes:

"I am entirely in sympathy with the movement fostered by the Associated General Contractors and other business interests to award highway contracts in September and October instead of in the

spring months. However, owing to the conditions that confront this department, especially as to appropriations to be made by the Legislature, it will be impossible for us to let over 50 per cent of the highway work that we expect to put under contract to be built during the season of 1922 before April or May of that year. Our Legislature meets yearly and convenes on January 1st for the annual session. Appropriation bills are very rarely passed before March 1st, and at least 50 per cent of the work to be undertaken next year must await the action of the Legislature providing money to cover the cost of construction to be undertaken.

"We shall use every effort in this department to let as many contracts in the fall and early winter as possible, and to prepare plans for the remainder so that as soon as the appropriations are made and other details attended to we may contract for the work to be awarded as soon as possible in the spring."

North Dakota

Mr. J. E. Kaulfuss, Assistant Chief Engineer, Bismarck, N. D., writes:

"In a general way it would appear to be commonly more satisfactory to let contracts in the fall rather than in the spring, although there are some reasons for not doing so.

"In the case of shipment of materials, etc., it might be advantageous, on account of the freight car situation, etc., for materials to be delivered during the winter months, thus equalizing the freight traffic.

"The state highway work in North Dakota up to the present time has been, and probably for some time in the future will be, such that the quantity of materials required will be relatively small. Our work consists mostly of grading and drainage.

"It has been our experience that the contracting field in North Dakota has been so limited and is composed of such relatively small contractors that not a great many of our projects, even when let in early spring, are finished before the season is over. In most cases the projects run over into two seasons.

"We have endeavored to assist the contractor by dividing our projects into small sections of four, five and six miles with a separate contract for each section, so that on a large project he will be relieved of each section and given payment in full as he completes his several contracts.

"The situation in the past, during the war, and possibly even now, is such that it is most advantageous for the contracts to be let very shortly before the work can be begun and readily finished. There is some advantage in letting the contracts very early in spring instead of late the preceding fall, especially during the period of adjustment. The principal handicap, however, in early spring letting is that in northern states the ground is covered with snow and ice, which makes examination of the work difficult.

"It appears that a contractor bidding on work, especially in northern states, about seven months before actual work is intended to be begun, would bid higher because of the uncertainties that might result within the next half year."

Ohio

Mr. E. C. Blosser, State Highway Engineer, Columbus, Ohio, writes:

"Our engineers in the field are always so busy during the summer months with contract work that it is not feasible to get our surveys until some time in the fall; and it is always easier to work up the plans and estimates during the winter months than any other time of the year. And then, again, we do not desire to have our roads torn up during the winter months any more than is absolutely necessary. So that, considered as a general proposition, I would say that we are not in sympathy with the movement to award highway construction in September and October exclusively."

Rhode Island

Mr. I. W. Patterson, Chief Engineer, Providence, R. I., writes:

"I am very much in favor of awarding contracts in the fall rather than in the spring. It is not always possible for this department to award contracts in the fall because as a rule we are financed by appropriations made annually. Occasionally, however, special appropriations are made for expenditure during a period of years. When this is done, almost invariably we let our contracts in the fall."

Wisconsin

Mr. A. R. Hirst, State Highway Engineer, Madison, Wis., writes:

"I will say, very briefly, that we are not in sympathy with the movement under way to award highway contracts in September and October, for the following reasons:

"First, the prices for labor, teams, machinery and materials for the following year are not known as early as September and October. Both the contractors and the public are gambling with too many

unknown factors when they let contracts so far in advance of the actual time of construction.

"Second, mechanically it is almost impossible to have the plans ready so far in advance of the time of construction, because in northern states such as Wisconsin the surveys are made in the open season, and the engineering force is maintained through the winter by working on plans from the surveys made when it was possible to survey to advantage.

"Of course it might be said that the department could work two years ahead, but very few departments are financed two years ahead, and surveys made two years in advance would be apt to be obsolete before used.

"I have been chief engineer of a state highway department for fourteen years, and it is my absolute opinion that the plan suggested by the Associated General Contractors is impracticable.

"We are making every effort to let our contracts as early in the year as possible. We started lettings in January, and practically all of the contract lettings under our control had been made before May 1. It has been mechanically impossible to get out the plans any earlier, and even if it were not, we do not believe it good policy to start lettings for the year's work before January 1. The motto of the Wisconsin Highway Commission is "Build each year the work awarded that year." There are a few exceptions to this rule in our practice, but very few indeed."

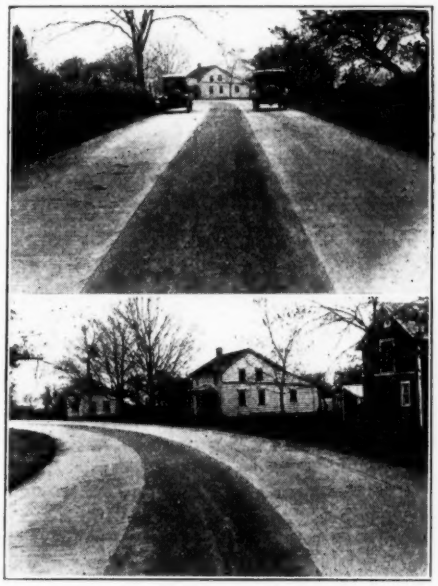
ADVANTAGES OF NEW YORK DUAL TYPE (MACADAM AND CONCRETE) ROAD

By H. G. Hotchkiss, Jr., Second Deputy Commissioner, New York Commission of Highways, State House, Albany, N. Y.

The dual type of road, consisting of macadam and concrete, has been used in the reconstruction of old macadam pavements to a small extent in four different counties of the state; namely, Dutchess, Livingston, Montgomery and Rensselaer, with the result that we now have in use five and one-half miles, all located on main heavily traveled routes and we anticipate the construction of a few additional miles during the present season.

The type in general consists of the placing of two strips, each 9 ft. in width, of concrete 1:1½:3½ mix of 6 in. uniform thickness reinforced with metal mesh separated by a strip of bituminous macadam penetration method, 6 ft. in width.

The advantages of this type are obvious. The width is ample to take care of present and probable future traffic on our main routes. The black strip of bituminous macadam tends strongly to keep traffic on its proper side of the pavement. Slow moving heavy trucks will drive on the concrete on the side of the pavement not monopolizing the center as is common on ordinary hard surfaced pavements. This permits fast moving pleasure or transportation vehicles readily to pass the slower moving vehicles. Traffic in general is confined to the concrete which is able to support and carry it without injury.



VIEWS OF MACADAM - CONCRETE DUAL TYPE OF HIGHWAY ON MAIN TRAVELED ROAD BETWEEN ALBANY AND NEW YORK, N. Y.

In reconstruction work, there is no necessity of closing the road to traffic during the progress of the work, as the strip of concrete is completed on one side of the center line and opened to traffic prior to the laying of the second strip of concrete.

Ample width of right of way and embankment or cut is required.

Reconstruction of old macadam pavements with this type of pavement costs approximately $40,000 per mile.

In the establishment of the new grade or profile, we endeavor to preserve and utilize as a foundation as much of the

old macadam pavement as is feasible.

Herewith are two views showing sections of the Schodack Center-Valatie, Pt. 3, Highway No. 5084, Rensselaer County, reconstructed in 1920, using this type of construction. This highway is located on the main traveled route between Albany and New York City. The photograph showing the touring car on one side with motor truck on the other illustrates well the opportunity for fast traveling vehicles to pass other vehicles going slower or standing still on the pavement.

CARIBOU HYDRO-ELECTRIC DEVELOPMENT OF THE GREAT WESTERN POWER COMPANY ON FEATHER RIVER

By Howard L. Rogers, Director of Division of Construction and Engineering, Stone & Webster, Inc., 147 Milk St., Boston, Mass.

The Great Western Power Co. of California has just put into operation a 60,000 horse power hydro-electric plant in Plumas County, California, serving Central and Northern California.

Power Possibilities of the Feather River

It is the second plant to be constructed in a comprehensive scheme for the development of power along 75 miles of the Feather River, which stream possesses unusual power possibilities.

Rising in the Sierra Nevada Mountains, the north fork of this river meanders across a great mountain meadow miles in length at an elevation of almost a mile above the ocean. Upon leaving the meadow it plunges abruptly into the Feather River Canyon and for 75 miles tumbles over one cascade and rapid after another until it finally reaches the gently sloping Central Valley system of California near Oroville. In this distance the river has fallen 4,285 ft., constituting a power zone within which, it is calculated, 640,000 horse power will ultimately be developed.

The plant just completed is known as the Caribou development. It receives its name from the century old trail along the river made by the caribou in their yearly migrations from the mountain tops to the warmer valleys.

Big Meadows Reservoir

The Big Meadows Reservoir is the key to the whole situation; it acts as a regulator for the two existing plants and will do so equally well for the five yet to be developed on the stream below. With an hydraulically sluiced earth dam built some 10 years ago across the neck of the valley, a lake 44 square miles in extent has been brought into existence. In this the flood waters from the higher mountains can be stored, to be released as needed during the dry California summers. Thus, a constant flow can be maintained, assuring a steady and reliable production of power.

The plant is located about 10 miles from the Big Meadows reservoir and is reached by a 10 mile construction railroad branching from the Great Western Railroad at Belden, Cal.

Essential Features

The development consists of the construction of two tunnels, each about 2 miles long, a small earth dam, the penstocks, power house and transmission lines.

The Big Meadows reservoir is tapped by a tunnel which conveys the water 2 miles to spill it into the valley of Butt Creek. After following the course of the gently sloping Butt Creek for about 10 miles, a low earth dam turns the water into the second tunnel about two miles long, which runs direct to the penstocks at the power house.

Driving the Tunnel

The driving of the tunnel which taps the Big Meadows reservoir was unusually difficult work, as there was a strong flow of water through the slate and jointed lava beds in which the tunnel was excavated. To keep it unwatered during construction, electrically driven pumps were employed. A duplicate set of steam pumps always stood ready to carry on at a moment's notice in the event of sudden failure of power. At one of the shafts 7,000,000 gals. per day were pumped constantly for more than a year. The second tunnel was much drier and more easily constructed.

Largest Impulse Wheels Yet Constructed

The Caribou development is notable even in this California region of high head power developments, in that the impulse wheels installed are the largest yet constructed. With a net effective head of 1,008 ft., each wheel is designed to absorb and transmit 15,000 horse power to the generator from the 11 in. jet of rushing water. Each of the 21 buckets of the wheel weighs 1,000 lbs., and is struck by a solid bar of water 11 ins. thick, shooting from the nozzle at a speed of 175 miles per hour. The wheel revolves at 171.4 revolutions per minute, receiving 60 blows every second, each one of which strikes with a force of 84,000 lbs. The energy delivered to each wheel is equiv-

alent to the crashing impact of 2 passenger locomotives, each weighing 100 tons and speeding at 42 miles per hour with but one second of headway between each locomotive.

Highest Transmission Line Voltage Yet Attempted

The transmission line is 185 miles long and will carry power at 165,000 volts, which is the highest transmission line voltage yet attempted.

The plant was designed and built by Stone & Webster, Inc., of Boston, under the direct supervision of S. L. Shuffleton, Western Manager, with W. D. Shannon as General Superintendent.

General Data Caribou Power Plant

The general data pertaining to the plant follow:

Great Western Power Company of California.

Work started June, 1919. In operation May 7, 1921.

Installed capacity, 59,000 horse power. Ultimate capacity, 167,000 horse power.

Location: Ten miles below Lake Almanor (Big Meadows Reservoir) on North Fork of Feather River, in Plumas County.

Power house construction: Reinforced concrete. Height, 105 ft.; width, 104 ft.; present length, 176 ft.; ultimate length, 308 ft.

Present installation: Two 30,000 horse power units, consisting of two overhung impulse wheels, each with 21 buckets, operating under a head of 1,008 ft., with a speed of 171.4 revolutions a minute. Each of the buckets on these wheels weighs 1,000 lbs. The diameter of the jet which strikes them is 11 ins. These two wheels and generator constitute a unit. Each unit weighs 290 tons; the revolving element of each unit weighs 170 tons.

Transmission: Aluminum cables, nearly 1 in. in diameter, transmit the power generated at the Caribou plant over double steel tower transmission lines 186 miles to the San Francisco Bay district distributing area. The voltage is 165,000, a world's record in transmission voltage.

Water supply: Water from Lake Almanor and Butt Valley is fed to the Caribou's power plant through three tunnels as follows:

Tunnel No. 1. Located between Lake Almanor and Butt Creek. Area, 46 sq. ft. Section rectangular. Slope, 1 per cent. Length, 11,200 ft., with three shafts. Lining, part concrete and part wood. Capacity, 800 cu. ft. of water per second. Equipped with two 7-ft. electrically controlled gates at its entrance.

Tunnel No. 2. Located between the south end of Butt Valley and the crest of the river gorge. Area, 78.50 sq. ft. Section, circular. Diameter, 10 ft. Slope, eight-tenths of 1 per cent. Length, 9,200 ft. Number of shafts and adits, two. Lining, concrete. Capacity, 1,400 cu. ft. of water per second. Equipped with a 9-ft. electrically controlled gate at the entrance.

Pressure Tunnel. Located between the crest of the gorge and a point under the ridge 550 ft. below. The area of the pressure tunnel is 63.62 sq. ft. Section, circular. Diameter, 9 ft. Length, 550 ft. Lining, combination steel and concrete.

Pipe Lines. Located partly in tunnels and partly on hillside between lower end of pressure tunnel and power house; 2,755 ft. of 60-in. steel pipe, 3,372 ft. of 42-in. pipe. Sixty-inch pipe is approximately ½ in. thick, and 42-in. pipe is approximately 1 in. thick.

A surge chamber 30 ft. in diameter and 175 ft deep, to take care of water suddenly backed up when the volume flowing through the generating units is reduced, is situated at the junction of Tunnel No. 2 and Tunnel No. 3.

The water used at the Caribou plant is used over again at the Big Bend power plant and ultimately will be used in all seven times at seven different power stations before reaching the Oroville or Sacramento Valley level, when it becomes available for irrigation.

EFFECT OF AGE ON STRENGTH OF CONCRETE

By Duff A. Abrams, Professor in Charge Structural Research Laboratory, Lewis Institute, 1951 W. Madison St., Chicago, Ill.

(Editor's Note: This discussion by Professor Abrams was prompted by certain comments in the recent report entitled: "A Study of the California Highway System," by the U. S. Bureau of Public Roads. It will be noted that Professor Abrams disagrees entirely with the authors as to the interpretation of the diagram printed on page 114, of the report mentioned, from which they conclude that the tests carried out show a tendency for the concrete to decrease in strength with age.)

Figure 1 is reproduced from "A Study of the California Highway System," by the U. S. Bureau of Public Roads, 1920, page 114. Compression tests were made on 4½-in. concrete cores cut from the pavements. The strengths have been corrected for length of specimen as compared

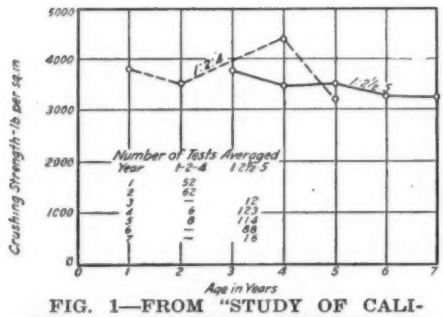


FIG. 1—FROM "STUDY OF CALIFORNIA HIGHWAY SYSTEM" BY THE U. S. BUREAU OF PUBLIC ROADS; 1920, page 114.

with their diameter and weighted on the basis of the number of tests included in a given average. The report contains the following comments on these tests:

"The strength of the concrete is very nearly constant for all pavement classes, and, with the exception of Class A, the average for 1-2-4 concrete for the various classes is higher than for the 1-2½-5. The general average for both 1-2½-5 and 1-2-4 concrete decreases with age with a single exception of 1-2-4 concrete at 4 years and 1-2½-5 concrete at 5 years. In the case of 1-2-4 concrete only 6 specimens were tests at the age of 4 years, which may account for the comparatively high results. In general, there seems a slight tendency for the concrete to decrease in strength with age. This general tendency follows also within the various pavement classes, although there are several exceptions."

The same diagram appeared in "Public Roads" for April, 1921, in an abstract of the above-mentioned report, with the following comments:

"(b) That since the average corrected testing strength of concrete cores is above 3,000 lbs. to the square inch the concrete itself is not generally defective in strength nor does it show any wear by traffic.

"(c) The average class condition of all concrete pavement indicates a slow progressive deterioration with the age of the pavement, and indicates also that the type built tends to reach its approximate stage of classification comparatively soon and thereafter to change more slowly.

"(d) The diagram showing average strength as determined by cores tested from concrete laid during the various years indicates that there may be a slow progressive deterioration of the concrete itself, or 'fatigue' in a thin slab subject to excessive flexure."

It seems to the writer that the authors of the above-mentioned reports have misinterpreted this diagram when they state that these tests show "a slight tendency for the concrete to decrease in strength with age" and "that there may be a slow progressive deterioration of the concrete itself, or 'fatigue' in a thin slab subject to excessive flexure."

The writer can find no evidence either in the reports of the Bureau of Public Roads or elsewhere to indicate that the compressive strength of this concrete was reduced by "fatigue in a thin slab, due to excessive flexure." The first evidence of excessive flexure would be a tension crack in the concrete. It seems extremely unlikely that enough of these cores contained such cracks, even if in incipient form, to cause a material reduction in compressive strength, especially when we consider that the cores were loaded at right angles to the flexural stresses.

The writer places an entirely different interpretation on the tests in Fig. 1. Instead of showing a progressive deterioration of the concrete, it shows that there has been a *progressive improvement in the quality of the concrete* during the period covered by the work of the California Highway Department—sufficient improvement in fact to more than counteract the advantages of age on part of the older concrete pavements. Although all the work was done under the same specification, it is probable that increased experience on the part of contractors, more careful preparation and proportioning of materials, better inspection, and other factors of this kind are responsible for the marked improvement in quality of the concrete.

The notion that the strength of concrete deteriorates with age is based on the results of tension tests of mortar briquets. In a paper on the "Effect of Age on the Strength of Concrete," published in the Proc. American Society for Testing Materials, 1918, Part II, the writer showed that briquet tests of mortars gave entirely erroneous results, due to the shape of the specimen in which (as pointed out by Johnson in 1898 and by Coker in 1912) the stress across the section is far from uniform. In other words, the falling-off in strength of mortar briquets is due to the *form of specimen* and does not reflect the true properties of concrete. Tension tests of briquets practically always show this result both for water or air storage. On the other hand concrete which is in contact with moisture continues to increase in strength indefinitely. Tests were

cited in the above-mentioned report up to 9 years. (See "Concrete-Steel Construction" by Morsch.) Under these conditions the strength is a logarithmic function of the age; in other words the strength is proportional to the logarithm of the age, expressed in weeks or months.

Water is necessary for the continued hydration of cement. Consequently, if the concrete *dries out* there is little or no further increase in strength. This shows the importance of keeping concrete moist for several days after it is placed. Tests reported in our Bulletin 2, "Effect of Curing Conditions on the Wear and Strength of Concrete," showed that the presence of moisture during the first few days exerted a most important influence on both the strength and wearing resistance of concrete.

A study of a large number of tests made in the Structural Materials Research Laboratory gives the relations between age and strength of concrete cured under different conditions, shown in Table 1 and Fig. 2. The values are platted to

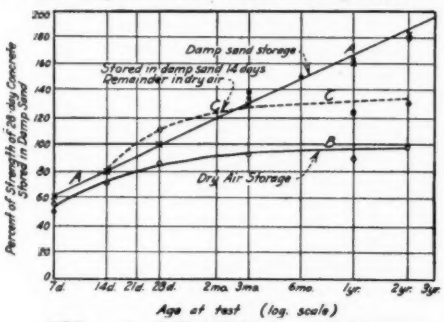


FIG. 2—RELATIONS BETWEEN AGE AND STRENGTH OF CONCRETE CURED UNDER DIFFERENT CONDITIONS.

a logarithmic scale of ages. Each of the values for damp sand or moist air storage (Curve A) is based on about 100 tests made in 6 different series made over a period of about 5 years. The points for Curves B and C are each the average of 15 tests. The concrete was of mixtures similar to that used in road construction.

Curve A illustrates the point made above to the effect that so long as moisture is present the strength of the concrete is proportional to the logarithm of its age. Both Curves B and C show that no material increase in strength may be expected after the concrete has fully dried out. The strengths due to intermediate conditions of storage will fall somewhere in the region between Curves A and B.

If concrete is exposed to moisture at any time after being dried out, the hydration of the cement is resumed, as shown by the increase in strength of the concrete. The process of hardening is simply arrested during the period when the concrete is dry. It was shown by tests made at the University of Illinois and reported by Prof. H. F. Gonnerman in Proc. American Concrete Institute, 1918, p. 101, that specimens which had been in dry air for 2 years showed a rapid increase in strength when placed in damp sand. In these tests there was little or no increase in strength in the air-stored specimens between 1 month and 2 years.

Another valuable report will be found in a recent paper entitled, "Effect of Age and Curing Conditions on Concrete—Results of 10-year Tests," by Prof. M. O. Mithey, published in the Wisconsin Engineer, Nov. 1920, and in Engineering and Contracting, Nov. 24, 1920. These tests showed that concrete cylinders stored in forms for 3 days, sprinkled daily until 14 days old, then placed outdoors with ends in contact with damp soil, gave strengths up to 10 years which were only slightly less than for similar specimens stored in water for the entire period.

In roads where the concrete may receive moisture from the damp sub-grade and from seasonal rains and snows we would expect to find a gradual ascent in the age-strength curve for an indefinite period of years. There is no reason to anticipate a reduction in strength with age, even in arid regions. After a careful study of all available data on the subject the writer can state with the utmost confidence that under normal conditions *concrete in roads does not deteriorate in strength with age.*

TABLE I—EFFECT OF AGE ON THE STRENGTH OF CONCRETE.

Compression tests of 6 by 12-in. cylinders.
28-day strength of specimens stored in damp sand (or moist air) considered as 100 per cent.
Mixtures 1-5 and 1-4; aggregates, sand and pebbles graded up to 1½ in.; consistency similar to that used in road construction.
(A), (B) and (C) refer to corresponding curves in Fig. 2.

Relative Strengths of Concrete for Different Curing Conditions

Age at Test	Damp Sand or Moist Air (A)	Dry Air (B)	Damp Sand 14 Days Remainder in Dry Air (C)
3 days	25%	30%	25%
7 days	60%	55%	60%
14 days	80%	70%	80%
28 days	100%	85%	110%
2 months	120%	92%	125%
3 months	130%	93%	127%
6 months	150%	95%	130%
1 year	165%	95%	130%
2 years	185%	96%	130%
3 years	195%	.....	.....

AND YET ONCE MORE—SEWAGE TANKS

To the Editor:

Since my communication regarding sewage tanks appeared in your February issue I have been watching and hoping for further comment from Mr. Kirchoffer. Today, upon the receipt of the July magazine, I was rewarded. I thank Mr. Kirchoffer for his interesting and courteous criticism no less than for his expressions of appreciation.

I fear, however, that in my former letter I did not make clear the advantages which, I firmly believe, are possessed by the tank with diverging side walls over the tank with parallel side walls. Mr. Kirchoffer says:

"I can scarcely agree with him that the slight difference in width of tank which would reduce the velocity about 2 to 3 in ratio would prove a means of sorting out food for different kinds of bacteria."

The inference from this seems to be that the reduction of velocity is too slight (only 33 per cent) to accomplish much in the way of improved sedimentation. For the benefit of the lay reader (Mr. Kirchoffer of course knows it) let me explain that the transporting power of moving water varies—not as the velocity, but as the sixth power of the velocity. I quote from LeConte's "Elements of Geology":

"The *Erosive* power of water, or its power of overcoming cohesion, varies as the square of the velocity of the current.

"The *transporting* power of a current varies as the sixth power of the velocity. . . . If the velocity, therefore, be increased 10 times, the transporting power is increased 1,000,000 times. A current running 3 ft. per second, or about 2 miles per hour, will move fragments of stone of the size of a hen's egg, or about 3 ounces weight. It follows from the above law that a current of 10 miles an hour will bear fragments of 1½ tons, and a torrent of 20 miles an hour will carry fragments of 100 tons. We can thus easily understand the destructive effects of mountain torrents when swollen by floods."*

A reduction of *velocity* in a 3 to 2 ratio therefore means a reduction in *transporting power*—and a consequent variation affecting the settling of suspended matter—covering a 729 to 64 ratio, or something more than 11 to 1, surely enough to effect a decided classification or "sorting out" of the deposited solids. Compared with the mean velocity—that is with a velocity through a tank of the same length, depth and capacity and with parallel walls—the lower velocity *at the outlet end* cuts the transporting power to almost one-third, for the ratio becomes 729 to 224. Because of this the tank is able to withhold much light flocculent matter that would be carried through and out by the current in a parallel-walled tank.

Mr. Kirchoffer continues:

"It is possible that a plain box type septic tank would have given equally good results for an equal length of time."

I think he has overlooked my statement that the expressed opinion was based upon "prolonged tests of such a tank, side by side with one of equal capacity but with parallel walls." The two tanks were fed equally and simultaneously with sewage from the same pipe; and the flaring tank proved the better.

As for the question

"Can he guarantee that if he should install it where conditions have arisen, where other types of tanks have failed to produce the desired results, that it would give a satisfactory effluent?"

I cannot answer better than by repeating and emphasizing Mr. Kirchoffer's own words:

"No type of tank, no matter how well designed, will work equally well on all sewages, nor will any one type of tank give satisfactory results all of the time on the same sewage."

I heartily concur in the opinion that the chemical quality of the water supply is an important factor in the behavior of sewage disposal units. Foreign elements, even in minute amounts, often have far-reaching effects. I have frequently found it expedient to use coke as a filtering medium, and I soon learned that a sulphur content in this material of more than one per cent caused foul odors, black deposits and a darkened effluent, when all other conditions were right for high standard service.

I believe the Kirdorthoff tank is as good as its designer claims; but where the construction of deep tanks is going to prove unduly costly—as in quicksand or rock, I think I am still likely to build single-story tanks and make them as efficient as I can. Very truly yours,

G. EVERETT HILL,
Vice President and Chief Engineer,
City-Wastes Disposal Co.
45 7th Ave., New York, Aug. 18, 1921.

*See also Flynn's "Flow of Water in Irrigation Canals," Moore's "Sanitary Engineering" and Metcalf and Eddy's "American Sewerage Practice."

OLD ROMAN ROAD DISCOVERED

Discovery has been made in England of another old Roman road hitherto unknown. Workmen who were digging manholes in the Alton road, where the latter joins the roads to Bentley and Bordon, near Farnham, Surrey, unearthed, 5 ft. below the surface, part of what appears to be an old Roman road that ran from London to Manchester. The road was in an excellent state of preservation, the surface layer being a foot in thickness and composed of flints. In order to penetrate the surface the workmen had to use drills and steel wedges. Research has demonstrated that not only the Romans used bituminous materials, including asphalt, but the ancient Sumerians, Persians, Babylonians, Greeks and Egyptians as well. The road discovered in England, according to engineers, was capable of carrying traffic heavier than any to which modern roads are now put.

ASPHALT PAVING IN THE DISTRICT OF COLUMBIA

By F. S. Besson, Major, Corps of Engineers, U. S. A. Assistant to the Engineer Commissioner, District of Columbia, District Bldg., Washington, D. C.

The City of Washington occupies an outstanding position in the development of bituminous pavements, particularly of that type known as sheet asphalt. In 1876, Pennsylvania Avenue from the Capitol to the Treasury was paved with a surface of asphalt on a concrete base. That section of the avenue between First and Sixth streets was laid by the Neuchatel Paving Company. This pavement was of the same character as those laid on the roadways in Paris about that time. It was composed of natural bituminous limestone brought from Switzerland, placed on the street in the form of powder, and compressed with iron rammers. The pavement used on the section from Sixth Street to Fifteenth Street differed from that of the Neuchatel Company in that the surface was an artificial mixture, the investigations and practice in Washington thereby taking on an entirely different line than those in Paris. A mixture of sand and limestone powder was made into a mastic by the use of an asphalt cement which was a combination of native asphalt, known as "mineral bitumen" and petroleum oil. The asphalt cement was used in about the proportion of 15 of cement to 85 of sand and limestone dust. This was the first use in the District of what is known today as sheet asphalt.

Early Bituminous Concrete Pavements

Prior to 1875, many so-called concrete pavements were laid of which the cementing substance was a product of coal tar oftentimes mixed with a certain proportion of asphalt. The construction of these pavements was covered by various patents. It appears that there were more than 150 such patents. Some of the pavements laid were purely experimental. In many the coal tar was hardened by the application of sulphuric acid, either the acid or powdered sulphur in its crude state, in the belief that the pavement was thereby vulcanized. When asphalt was mixed with the coal tar it was usually Cuban, as, in those early days, it was believed by many that Trinidad was too brittle for pavements. Some of these early patented pavements went to pieces almost immediately, most of them required continuous and excessive maintenance, and a few still remain serving as base for asphalt surfaces.

Early Nomenclature

In view of discussion today as to the nomenclature that should be used relative to Portland cement concrete and asphalt cement concrete, it is interesting to note that this old bituminous construction was known as "concrete pavement," and that which most of us at present think of as concrete was habitually spoken of as "hydraulic cement concrete."

An early District of Columbia report states that on the first of January, 1881, there were 360,000 sq. yds. of asphalt pavements on hydraulic concrete base and 700,000 sq. yds. of concrete pavements with a bituminous cementing substance, giving a total of 1,060,000 sq. yds. of monolithic or smooth surface pavements extending over a length of 44 miles. The report further states: "This is considerably more than exists on the roadways of all other cities in the world taken together; the amounts for other cities being as follows:

	Square Yards	Miles
Paris	370,000	19¾
London	150,000	6½
New York	20,000	1
Other cities (estim'd)	60,000	2¾
	600,000	30

Pavement Performance in Washington

The use of a concrete base for the asphalt pavement on Pennsylvania Avenue was the initiation of a standard the value of which today is attested by al-

most a half century of practice. Lieutenant F. V. Greene, Assistant to the first Engineer Commissioner of the District, spoke 40 years ago of this type of pavement as one with "a solid base of concrete masonry, practically imperishable, and a comparatively thin and smooth wearing surface which can be replaced when it is worn out—say every 15 or 20 years." It is seldom that a predictive statement such as this in the field of road construction withstands the test of time. It has been said that there is nothing permanent about a road except its right of way. Surely Washington's experience has shown that a properly constructed concrete base is permanent. The original one in Pennsylvania Avenue was resurfaced with new asphalt in 1890. The sections between Third and Fifteenth Streets were again resurfaced between 1907 and 1912. The 1890 surface still exists between First and Third Streets. Generally it has been found that asphalt pavements on concrete base require replacement of the asphalt after it has given an average service of from 25 to 30 years. Of today's total of 3,334,157 sq. yds. of asphalt surface in Washington there are 670,000 sq. yds. beyond 25 years of age.

Early Construction Methods

Asphalt paving work of today differs greatly from the practice when Pennsylvania Avenue was first surfaced. At that time asphalt cement was prepared and combined with the aggregate by primitive methods. When spread upon the street it was thought that the hot mixture could not be rolled. Old residents state that it was an interesting sight to see a row of darkies stretched across the avenue standing on planks and compressing the asphalt with hot tampers, followed by another string of darkies with smoothing irons. Natural hydraulic cement was used in the concrete base, the mixing of which was done by hand.

Modern Construction Methods

Figure 1 shows a plan and typical section of the plant of a Washington contractor. This plant is located on the river front and the haul to the various streets in a season's contract usually averages about 2½ miles. Not only does this plant serve as a central mixing station for asphalt mixtures, but also for concrete. Hauling is done by 5-ton motor trucks, the development of which has done as much for the expediting of road construction as any other one item. Aggregate, both for concrete and asphalt mixtures, is hoisted from barges to a transfer hopper by means of a clam shell bucket and delivered in automatic dump cars to the storage bins by gravity, counterweights returning the cars to the hopper.

For concrete a mixer is used with a rated capacity of 8 cu. ft. of mixed concrete. A batch for the base mixture contains 1 bag of cement, 3 cu. ft. of sand, and 7 cu. ft. of gravel. The motor trucks drive directly under the mixture discharge and eight batches fill a truck, making a load of slightly more than 2 cu. yds. of mixed concrete weighing about five tons. A 16 cu. ft. mixer, which is twice the size of the present one, is being installed, the use of which will materially cut down the idle time of the trucks waiting for full load, with a commensurate reduction in hauling costs. The maximum time for a truck from the mixer to the job has been not more than one hour and a quarter. A relatively dry concrete is used, the slump being less than 1½ ins., when tested with a truncated cone the base of which is 8 ins., the top 4 ins. and the height 12 ins.

Unit Cost Data

A truck load lays approximately 12 sq. yds. of base 6 ins. thick. The average laid in a day of eight hours totals 750 sq. yds. Concrete is dumped on the subgrade, spread and tamped by hand. Grades are followed by the old grade peg method, as no entirely satisfactory substitute therefor has been found. The concrete gang on the street consists of 1 foreman, 4 men adjusting grade and miscellaneous work, 4 spreaders and 2 tampers. On the basis of a daily total of 750 sq. yds., the following analysis may be made:

.161 bbls. Cement	@ $2.00	= .419	per sq. yd.
.07 cu. yd. Sand	@ .80	= .056	per sq. yd.
.165 cu. yd. Gravel	@ 1.20	= .198	per sq. yd.
Total for Material.....		$0.673	per sq. yd.
Hauling		0.250	

1 Foreman	@ $45 per week	= $ 7.50 per day
5 Laborers	@ $4.50 per day	= 22.50
5 Laborers	@ $4.00 per day	= 20.00
		$50.00 per day

Total for men on the street, 750 sq. yds. = .067 per sq. yd.
Concrete Cost, Total Outside of Plant $0.99 per sq. yd.

There are three asphalt mixers of the open top bin type with the mixing blades of teeth bolted to a horizontal shaft. Bins for the heated aggregate are located directly over the mixers, and attached to the bins are accurately measured boxes so that the correct amount of aggregate

may be added to each batch. Hot Asphalt Cement is brought to measuring buckets at each mixer from the melting kettles by compressed air. The mixers discharge directly into motor trucks on the driveway beneath them.

The Binder

The composition of binder by weight, as given by the average of a number of tests during the past year, is as shown in Table I.

For one mixer batch a predetermined amount approximately 25 lbs. of asphalt cement and 8.2 cu. ft. of binder stone are used. Binder shrinks in the mixing so that the resultant batch measures but 7.6 cu. ft. Fourteen batches fill a truck giving a load of 106 cu. ft., weighing about 5 tons. This amount lays 84 sq. yds. of 2 in. binder which compresses by rolling to 1½ ins.

The Top Mixture

An average analysis of topping mixture is as given in Table II.

A batch for the mixer consists of 8 cu. ft. of sand, 75 lbs. of limestone dust and 100 lbs. of asphalt cement. Twelve batches, 96 cu. ft., make a truck load weighing approximately 5 tons. This amount lays 66 sq. yds. of 2½ in. topping which compresses under rolling to slightly more than 1½ ins.

The asphalt gang on the street consists of 1 foreman, 8 spreaders, 4 rakers and 2 tampers, with a 5-ton and a 10-ton roller. A batch of binder lays 6 sq. yds. and of topping 5.50 sq. yds., therefore on the basis of a daily total averaging 1200 sq. yds., comprising both binder and topping, the cost per square yard of asphalt surface may be analyzed as shown in Table III.

The separate units in the plant are not described herein since descriptions of such installations are readily obtainable in various reference books. Of primary interest is the combination of units or plant layout which is shown in sufficient detail in the drawing. The unit prices used in the cost data are current ones and not necessarily those paid by the contractor. No attempt can here be made to set down in itemized form the cost of a contractor's plant operation and depreciation, overhead and other similar charges. The probable cost of asphalt surface per square yard may be obtained by adding to the figures thus far given in the present article known data pertaining to the operation of District of Columbia plant. Such plant is small and figures relative thereto are at least conservative when applied to a larger plant. The data would be as in Table IV.

Factors Favorable to Construction

The cost per square yard estimated in the preceding paragraph is approximately

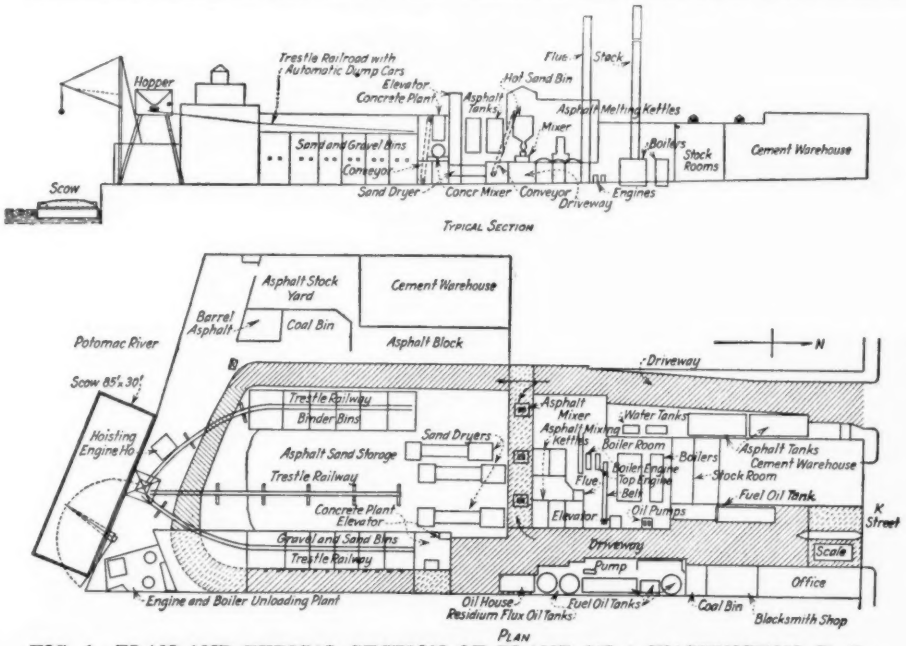


FIG. 1—PLAN AND TYPICAL SECTION OF PLANT OF A WASHINGTON, D. C., ASPHALT PAVING CONTRACTOR.

TABLE I—COMPOSITION OF BINDER BY WEIGHT.

	Per cent passing the following mesh:												
% Bit.	1½	1	¾	½	¼	10	20	30	40	50	80	100	200	Total
3.9	1.4	15.9	25.2	32.1	14.2	1.7	.7	.6	.5	.8	.3	1.4	1.3	100%

TABLE II—AVERAGE ANALYSIS OF TOPPING MIXTURE.

	Per cent passing the following mesh:												
% Bit.	1	¾	½	¼	10	20	30	40	50	80	100	200	Total
11.3	0	0	0	0	4.9	9.8	10.2	17.1	18.5	9.6	12.8	5.8	100%

TABLE III—COST PER SQUARE YARD OF ASPHALT SURFACE.

4.16 lbs. Asphalt Cement @ $18 per ton	= .037	
1.37 cu. ft. Binder Stone @ $2.88 cu. yd.	= .146	
Total Material Cost for Binder		.183 per sq. yd.
18.18 lbs. Asphalt Cement @ $18 per ton	= .164	
13.63 lbs. Lime Stone Dust @ $4.50 per ton	= .031	
1.45 cu. ft. Sand @ $2.08 cu. yd.	= .112	
Total Material Cost for Topping		.307 per sq. yd.
Hauling		.100 per sq. yd.
One Foreman @ $45.00 per week	$7.50 per day	
Ten Laborers @ $4.00 per day	40.00 per day	
Four Rakers @ $4.80 per day	19.20 per day	
	$66.70 per day	
Total for labor on street, 1,200 sq. yds.		.055 per sq. yd.
Rolling		.030 per sq. yd.
Asphalt cost total outside of plant		.675 per sq. yd.

TABLE IV—UNIT COSTS FOR ASPHALT PAVEMENTS.

Concrete Base, Cost outside of Plant	$0.99	per sq. yd.
Asphalt Surface, Cost outside of Plant	0.68	per sq. yd.
Concrete Plant charges and operation	0.20	per sq. yd.
Asphalt Plant charges and operation	0.40	per sq. yd.
10% Overhead and 10% Contingencies	.45	
	$2.72	
15% Profit for Contractor	.48	
Probable Contractor's Bid	$3.20	per sq. yd.

70 cts. less than usual bids during the late summer and fall of 1920. Many uncertainties have passed. Men, instead of bartering for higher wages, are anxiously seeking employment. Last summer contractors bought their materials subject to problematical increases because of freight rates. Shipments were erratic and contractors' forces were greatly slowed up thereby. Construction risks were at a maximum. Today conditions have changed; contractors are looking for work and an estimated reduction of 70 cents per sq. yd. is justified.

Sheet Asphalt on Concrete Base Meets Washington Conditions

For new construction, it appears that sheet asphalt on a concrete base meets Washington conditions, practically to the exclusion of other types. Of course, every possible protection is given the large investment represented by the great number of existing macadam streets, but all new work is habitually carried out with the sheet asphalt on concrete base standard in mind. In residential districts of a suburban nature and where it is desired to hold down present assessments, instead of a complete asphalt pavement concrete alone is laid, the mixture of cement and aggregate being much richer than that in the usual base for asphalt. These concrete streets are placed using the same crown formula as is used for asphalt construction, and additional height of curb above the roadway is shown over that for asphalt surfaces. This is in order that just prior to the appearance in the concrete of material signs of wear and after profitable use has been obtained, it may be surfaced with sheet asphalt. Thereafter the resurfacing cycle is expected to repeat every 25 or 30 years, the concrete itself being everlasting. However, the question of pavement types is one of design, a subject broad enough to require discussion in a separate article, and which it is hoped to treat of in the near future upon the completion of certain investigations now under way.

THE RAILROAD SITUATION YESTERDAY, TODAY AND TOMORROW

By E. A. Hadley, Chief Engineer, Missouri Pacific Railroad Co., St. Louis, Mo.

(Editor's Note: The following admirable and informative discussion of the railroad situation, which is of immediate concern to every citizen, was presented by Mr. Hadley before the Associated Engineering Societies of St. Louis on May 18, 1921, and printed in the Journal of The Engineer's Club of St. Louis for April, May, June, 1921. This discussion is so remarkably free from the customary partisan political and other forms of bias and prejudice and, withal, is so wholesome and refreshing in its tone that we consider it a credit to the engineering profession. The text is the author's; the editor assumes responsibility for the center headings.)

The three periods of time into which I propose to divide this discussion of the railroad situation places "Yesterday" as that period prior to March 1, 1920, "Today" as the period subsequent to that date up to the present moment, and "Tomorrow" as the future into which we can see but dimly and can only at best express our opinions and hopes based upon our past experience and the generally forward progress of our nation.

Amount of Railway Property

The first charter granted for the construction of a railroad, for the purpose of handling freight and passenger business, was in the year 1827, but it was nearly 20 years later before the real period of railroad construction was started in the United States and since which time a vast number of railroad companies have been formed, some of which are still operating lines of railroads and others of which have passed out of existence.

At the present time there are more than 1800 independent companies reporting to and under the control of the Interstate Commerce Commission in accordance with the Transportation Act of 1920, comprising a total main line trackage of about 265,000 miles.

Of these 1800 independent companies about 200 have an annual revenue in excess of $1,000,000.

During these 75 years, which period is within the life span of many persons who are still living and can remember the early days of railroads in this country, the business has grown to a point where the railroads together own about 2,400,000 freight cars, 69,000 locomotives and 57,000 cars designed for passenger service, and the total combined value of all railroad property is about $20,000,000,000.

Except for some assistance from the national government in the way of land grants and the assumption of certain obligations by some communities which expected to be benefited by the construction of a particular line of railroad, these properties have been built up almost wholly from private funds furnished in expectation of a satisfactory return on the money so invested.

Railway Regulation

Constructed under a competitive system, the service and rates in the earlier years were largely to the satisfaction of the railroads, the shippers and the public, but with the growth of the country and the rapid increase in the extent and power of some of the railroads, laws were passed discouraging further combinations and the Sherman Act and other similar laws practically stopped, not only the consolidation of competing railroads into one system, but also brought to a practical standstill those possible combinations which would result in more efficiently and economically serving certain large territories.

From a situation of practically no regulation or restraint under the law at their beginning, the railroads reached a point some eight or ten years ago, where they were so bound up and restricted by both federal and state laws and regulations, in some cases directly contradictory in adjoining states, that their operations were seriously handicapped and the situation was at least becoming uncomfortable.

Serious Plight of Railroads Just Prior to Federal Control

It is doubtless true that regulation was required in many cases, perhaps due to the ill-advised action of some railroad officials and financiers, but with one government body regulating the rates which might be charged on interstate movements of freight and passenger traffic and many of the state commissions trying to enforce rates on intrastate traffic, which were lower than the interstate rates, and therefore of supposed advantage to the citizens of such states, together with the multitude of general and specific laws aimed at railroads by the several state legislatures on the one hand and the demands of organized labor and the rising material market on the other hand, the plight of the railroads in the period just prior to federal control was indeed serious.

While some thought was given, pre-

vious to federal control of the railroads, to large consolidations of railroads into continental systems, the first real step of this kind came in the early part of 1917, when the railroads established their "war board" in an endeavor to co-ordinate the efforts of all railroads along proper lines to provide for the great increase in transportation of men and materials made necessary due to the entry of this country into the world war.

Financial "Breakdown"

A remark quite commonly heard in the early part of our participation in the war was that the transportation systems of the country had broken down under private management, making it necessary for the government to take over and operate the railroads.

I submit that if the railroads were broken down it was financially, due in a large part to unwise legislation and rates too low for profitable operation rather than physically, or in their ability to handle traffic, which conclusion is supported by the following facts:

In 1917 the railroads carried 127,000,000,000 ton miles more than they carried in 1915, and at the same time handled 200,000 empty cars, regardless of ownership, from one part of the country to another for war purposes.

Late in 1917, there was an excessive accumulation of loaded cars on the eastern seaboard, due in part to the severe weather conditions, but more largely to the fact that the railroads were delivering a greater tonnage than the capacity of the ships available for export and for our own manufacturers to handle.

War-Time Federal Control of Railroads a Wise and Necessary Measure

I believe, that under the then existing conditions, federal control of the railroads was a wise and necessary thing and prevented a more serious condition which otherwise would have prevailed, both physically and financially, as it firmly established the credit of the companies by the backing of our government at a time when most sorely needed.

This, in itself, to my mind, was sufficient justification for the action taken by the President of the United States in placing the railroads of the country under federal control on January 1, 1918.

Further, the director general of railroads appointed by the President was given full authority to consolidate railroads or separate them into two or more parts; to co-ordinate and operate them as he saw fit, regardless of federal or state laws which had so hampered the efforts of the private owners in their handling of traffic.

Priority Orders Created Confusion

Several branches of the government had also so encumbered the situation in the last months of 1917 by the issuance of "priority orders" for special and preferred movement of materials intended for war purposes that the utmost confusion was inevitable if this practice were further continued, as each department was insisting that its material be given preference in movement over that for all others.

Under the conditions of full control by the director general, there was moved in 1918 about 2 per cent more ton miles, and in 1919 about 7 per cent less ton miles of freight than were moved by the railroads themselves in 1917 under the direction of their self-constituted war board, but it is an open question as to what the railroads might have been able to accomplish if left to struggle along unaided and without relief from the burdensome laws and regulations with which they were hedged about.

Personally, I can readily imagine they might have been much worse off at the close of the war than the owners found them on their release from government control.

The act of Congress providing for federal control of the railroads stipulated that for the use of its property the railroad owners should be compensated in the same annual amount as its average net earnings per year for the three years ending June 30, 1917, and that the properties should be fully maintained by the government and returned to the owners at the termination of federal control in substantially as good condition in both roadway and equipment as when taken over on January 1, 1918, either by actual physical reparation or by payment to the railroad company the cost of such work as the director general failed to do, so that it might subsequently be done by the owners of the property.

Federal Control an Aid to Proper Maintenance

Taken as a whole, the railroads, while under the control of the government, even with increased freight and passenger rates, which it placed in effect, failed to earn the total amount of the compensation guaranteed by the Act and also the director general failed to fully maintain the properties, perhaps, due to causes beyond his control. However, it is estimated by the present director general that the cost to the government

for the twenty-six months of federal control was about $1,200,000,000, of which amount a part has been paid and the balance must be paid from the national treasury.

No one can positively say that the railroads, if operated independently, would have been able better to maintain the physical condition of their property than did the director general with the full resources of the nation at his command, but it is my opinion that they would, as a whole, have been in much worse condition without this help.

Present Conditions

We now come to that period, beginning with March 1, 1920, which I have designated in this discussion as "Today," when the owners resumed operation of the railroads under the so-called "Transportation Act of 1920," which guaranteed to the railroad companies for a six months period ending September 1, 1920, the same average net return as they had reeceived during the federal control period. So far as I can ascertain, no reliable estimates have as yet been prepared which will show the total amount which the government owes the railroads for this six months "guarantee period," but it is safe to say that it will run into the hundreds of millions of dollars.

Subsequent to September 1, 1920, the carriers were to be permitted to earn as a whole a 6 per cent return upon their fair value, but not, as many supposed, a guaranteed return of 6 per cent on the value of any individual carrier.

Any net earnings of an individual railroad above 6 per cent are to be divided equally between it and the government, but if any railroad is unable to earn the full 6 per cent with earnings from the regularly established rates, that is its misfortune and it has nothing further coming to it from the government, but it may be permitted to borrow money at a reasonable rate of interest from the government fund expected to be accumulated from excess earnings of other roads to enable such weaker road to so improve its property and equipment as to enable it, if possible, to earn 6 per cent on its value.

A Greatly Increased Pay Roll Returned to the Railroads

The railroad administration passed on to the railroads, and the wage board, created by the Transportation Act, further added thereto, a greatly increased payroll brought about by an increase in the total average number of employes of 19 per cent, or from 1,753,000 in 1917 to 2,054,000 in 1920, and an increase in the total wages paid of 115 per cent, or from $1,739,482,000 in 1917, to $3,742,487,000 in 1920, and had the increase been in the entire year of 1920 instead of from May 1st, it would have amounted to 128 per cent.

Rate Increases

These wage increases and the high cost of materials and supplies made necessary a further increase in freight and passenger rates to an extent which the Interstate Commerce Commission felt would provide the 6 per cent earnings on the value of all railroad properties, which it placed at a total of $18,900,000,000, as against a value of $21,000,000,000 claimed by the railroads as represented by their combined capital accounts.

These rate increases were made in an amount ranging from 25 to 40 per cent and were made effective September 1, 1920.

Present Rates Have Not Contributed to Depression

Statements have been made to the effect that the present freight rates are so high as to restrict and even prevent the movement of traffic and have, to a large extent, contributed to the business depression now existing in the country.

Permit me to call your attention to the fact that the total increase in freight rates, compared to the average commodity value per ton of freight handled, is only two-tenths of one per cent greater than it was in 1914, before the world war.

With the tremendously heavy financial burdens added to the cost of running the railroads, such as increased wages, increased taxes, higher rates of interest on borrowed money, etc., I contend that two-tenths of one per cent net increase over 1914 freight rates equated to 1920 values of commodities shipped is not excessive nor is it so great as to appreciably add to the cost of commodities to the ultimate consumer or to restrict or prevent shipments of freight.

Railways Efficiently Handled Since Return to Owners

It has also been said that the railroads have not been efficiently handled since their return to private operation, but the facts show very conclusively to the contrary.

The best record ever made for any year before 1920, with respect to the average movement of all freight cars per day, was in 1917, under private operation, the average distance being 26.1 miles.

In 1918, under government control, this fell to 24.9 miles, and in 1919, still under government control, it fell to 23.1 miles.

For the year 1920 this movement was steadily improved, giving an average for the year of 24.9 miles, the average for the last four months being as follows:

September	28.1 miles
October	28.5 miles
November	26.8 miles
December	24.8 miles

The average number of tons per loaded freight car was greater in 1920 than in either of the three previous years. These averages were as follows:

1917	27.0 tons
1918	29.1 tons
1919	27.8 tons
1920	29.3 tons

As the increase of car movement of but a single mile a day is equivalent to the addition of 100,000 new freight cars, this improved mileage, together with the increase loading per car, does not indicate inefficient management or restriction of transportation facilities.

Again, the best average train load for any month previous to 1920 was in September, 1919, under government control, when the average train carried 778 tons.

Eleven months later, however, under private control, in August, 1920, the record was again broken, the average train load in the United States for that month being 788 tons.

It has also been said that the railroads have not been properly managed since their return to private control and that operating expenses have not been properly controlled and have been excessive.

Why Operating Costs Are Excessive

I agree that the operating costs have been excessive, but properly to place the responsibility for such results, the underlying conditions must be known and understood.

The government, under the law, prescribes the charges from which operating revenue must come and likewise fixes the wages, through the government wage board, which wage constituted 64 cts. of every dollar of operating expenses in the year 1920.

Out of every dollar of operating expenses during that year 30 cts. were paid out for material and supplies.

The government operated the roads for two months of 1920 and, accordingly, agreed to the prices of materials and supplies for these months, as well as incurring all the operating expenses for these months.

The government also purchased or contracted for large quantities of materials and supplies which were passed over to the carriers on the return of the roads to private operation and these materials and supplies were, of necessity, charged into operating expenses for 1920 at prices fixed for the carriers by the government in making the purchases.

It is conservatively estimated that one-half of the materials and supplies used in the year 1920 were thus charged into operating expenses for that year at prices fixed by the government. Thus it is evident that 15 cts. out of every dollar of 1920 operating expenses for material and supplies was also fixed by the government.

All operating expenses (other than for labor, material and supplies) for the first two months of 1920 amounted to about 3.5 cts. of every dollar of operating expenses for the full year.

These were incurred by the government and not by the carriers.

Summing up, this means that 64 cts. for labor, 15 cts. for material and 3.5 cts. for other expenses, a total of 82.5 cts. out of every dollar of operating expenses for the year 1920 were paid out at prices directly fixed by the government.

The balance of the materials and supplies used during the year 1920 were purchased by the carriers at prices fixed by general market conditions, beyond their power to control, and which cost another 15 cts. out of every dollar expended.

In short, prices fixed by the government and by market conditions cover 97.5 cts. out of every dollar of operating expenses for the calendar year 1920.

This analysis, I believe, makes clear the very narrow limits within which efficiency of management might be used to control the remaining 2.5 per cent of the operating expenses, including transportation costs, and I think establishes the fact that by far the largest contributing cause to the abnormal amount of operating expenses for 1920 is the cost of labor.

The Future

Now, as to the future, the "Tomorrow" which I have heretofore mentioned. Railroads are subject to the same economic laws as is any other business and the decline in traffic and the failure of many commodities to move is not due to high freight rates, as above demonstrated, or any fault of the railroads who are suffering with others in a period of depression following a period of tremendous inflation. This is a situation of world-wide incidents arising from understandable

causes, most of them having their origin in the world war.

Either rates must be further increased or operating expenses must be reduced; if possible, to a point where rates can be lowered. This means wage reductions for railroad employes and such changes in the present indefensible working agreements as will promote efficiency and insure a full day's work for a full day's pay.

These changes, with a probable falling market for material and supplies, should bring about a greater and necessary margin between revenue and expenses, which is absolutely essential if the railroads are to continue to operate properly and expand to meet the needs of this growing country of ours.

That government body having control over the revenue of the carriers must also be charged with responsibility for the wage schedules which go to make up so large a part of the operating expenses if we are to continue to have railroad wages regulated by the government, instead of by the natural laws of supply and demand, otherwise we will continue to see the rates which provide the revenue following the lead of the wage board, thus giving that board far greater control over the ultimate cost of transportation than I believe the Congress of the United States ever intended it should have when the Transportation Act of 1920 was passed.

The credit of the railroads must be maintained by allowing reasonable net earnings.

There will mature in the four years, including 1921, the following obligations of the railroads, which constitute a part of their funded debt and which must be paid off or refunded.

1921	$322,473,000
1922	136,196,000
1923	82,648,000
1924	19,900,000

It would seem that if we can safely get through the present year, the worst of the financial situation will be over, but relief from the present situation must be speedily secured.

Predicts Consolidation Into Large Competitive Systems

I believe that the comparatively near future will see consolidations of the railroads into large competitive systems of from 15,000 to 20,000 miles each along the lines suggested in the Transportation Act of 1920, and that such consolidations will be worked out in spite of the seemingly almost insurmountable difficulties involved in the way of financial and legal complications.

The growth and development of our nation demands such co-ordination of our transportation facilities as will retain the good features of a centrally controlled railroad system for the entire country and still have the benefits which are the result of healthy competition between the carriers.

I believe that the railroads are about to pass out of the most trying situation which has ever confronted them and that they will shortly be on a substantial and satisfactory basis, following and perhaps leading in the general recovery of business and that we will continue to have, as at present and in the past, the most efficient railroads in the world operated at the lowest cost for freight and passenger movement.

HIGHWAY RESEARCH ON A NATIONAL BASIS

By Alfred D. Flinn, Vice-Chairman, Advisory Board on Highway Research.

The Advisory Board on Highway Research, of the National Research Council, announces that it has engaged as director, William Kendrick Hatt, Professor of Civil Engineering and Director of Materials Testing Laboratory, Purdue University, Lafayette, Ind. He is a member of the American Society of Civil Engineers, the American Society for Testing Materials, the American Railway Engineering Association and other technical societies. His work as an investigator in organizing the timber investigations of the U. S. Forest Service, and in other engineering and scientific fields for the past 20 years, is well known. Director Hatt began his duties July 1. His office is in the building of the National Research Council, 1701 Massachusetts avenue, Washington, D. C.

How the Advisory Board Was Established.

This Advisory Board was established by the Division of Engineering, of National Research Council, with the co-operation of Engineering Foundation, as the result of a conference held in New York, Engineering Societies Building, last November, attended by many representatives of national engineering societies, associations of vehicle and road materials manufacturers, Federal Bureau of Public Roads, State Highway Departments and universities.

By the terms of the by-laws, the membership of the Advisory Board is composed of those organizations of national importance interested in design, construc-

tion, economics, maintenance and financing of highways, in materials and equipment therefor, and in vehicles used on highways; governmental departments and bureaus of similar interests, and higher educational institutions.

Organization Members.

The present organization members are:

American Association of State Highway Officials.

American Concrete Institute.

American Institute of Consulting Engineers.

American Society of Civil Engineers.

American Society of Mechanical Engineers.

American Society for Municipal Improvements.

American Society for Testing Materials.

Association of American State Geologists.

Bureau of Public Roads, U. S. Department of Agriculture.

Corps of Engineers, U. S. Army.

Engineering Foundation.

Federal Highway Council.

National Automobile Chamber of Commerce.

National Highway Traffic Association.

Society of Automotive Engineers.

Officers and Purposes of the Board.

The officers of the Board are: Anson Marston, Chairman, Director, American Society of Civil Engineers, member of Iowa State Highway Commission, and Dean of Engineering, Iowa State College; Alfred D. Flinn, Vice-Chairman, Secretary, Engineering Foundation, and Vice-Chairman, Division of Engineering, National Research Council. Other members of the Executive Committee are Thomas H. MacDonald, Chief, Bureau of Public Roads, Department of Agriculture; George S .Webster, President, American Society of Civil Engineers, Consulting Engineer, formerly Director, Department of Wharves, Docks and Ferries, Philadelphia; Henry M. Crane, Chairman, Research Committee, Society of Automotive Engineers; W. H. Hatt, Director.

In addition to the member organizations, 13 State highway departments and more than 40 universities have definitely signified their interest in the work of the Advisory Board and their willingness to co-operate.

The purposes of the Board are:

(a) To assist existing organizations in outlining a comprehensive national program of highway research and co-ordinating their activities thereunder.

(b) To organize committees for specific problems.

(c) To act in a general advisory capacity.

(d) To serve as a clearing house for highway research information.

Three Technical Committees Already at Work.

Three technical committees have been at work for a number of months. These are:

1. Committee on Economic Theory of Highway Improvement, Chairman, Professor T. R. Agg, Iowa State College.

2. Committee on Character and Use of Road Materials, Chairman, H. S. Mattimore, Engineer of Tests, Pennsylvania State Highway Department.

3. Committee on Structural Design of Roads, Chairman, A. T. Goldbeck, Engineer of Tests, Bureau of Public Roads, Department of Agriculture.

The Executive Committee of the Advisory Board has the creation of additional committees under advisement, such as Committees on Vehicle Design as Related to a Road, on Economics and Cost of Transport, on Financing Highway Improvements, on Traffic Studies, and on Organization of Construction Plants.

Much valuable experimental research work is being done by the Bureau of Public Roads, the U. S. Army, several State highway departments, the universities, and a few associations of manufacturers of vehicles and materials.

Two of the most important elements of the strength of the Advisory Board are the membership and the active participation of the Bureau of Public Roads and the Army Engineers. The Bureau is represented by its Chief, Thomas H. MacDonald, who is supporting the research work most loyally and intelligently. To represent the Engineer Corps of the Army, the Chief of Engineers appointed Colonel E. Eveleth Winslow, stationed at New York, and the appointment was officially confirmed by the Secretary of War. Major Mark L. Ireland, of the Quartermaster's Corps, is a member of the Committee on Economic Theory of Highway Improvement. During the summer, with the cooperation of the Massachusets Institute of Technology, Major Ireland will conduct at Cambridge, Mass., an important series of tests on the traction resistance of vehicles and of road surfaces. Equipment and supplies have been provided and the necessary assistants assigned by the army.

Comprehensive Plan for Highway Research

Director Hatt's work is expected to stimulate experimental work by such organizations to much greater activity, just

as the work of the existing committees of the Board has already had a stimulating effect. The Director, in consultation with the Advisory Board, will prepare a comprehensive plan of the field of highway research, including Economics, Design, Construction and Administration, and will arrange a program of committee work for those fields that need to be occupied immediately.

The personnel of these committees will include active research workers within the state highway commissions, the universities, the governmental departments and other research organizations. A census will be taken of the research work completed and current, and the various research agencies will be invited to cooperate in an attack on those urgent problems upon the solution of which the future success of highway transport depends.

Direction, Not Duplication, of Effort

The Advisory Board will not duplicate the efforts of existing research groups. Indeed, it will not do any research work directly, but will act rather to promote a co-ordinated effort in a consistent national program, suggesting problems to those organizations best fitted to attack them. It will also serve as a clearing house for information.

As one Highway Commissioner has expressed the present need, "I have $10,000,000 to spend on roads in my state this year. I know that I could save $500,000 by properly directed research studies. If your board will tell me what other states are finding out and what research work I should do to supplement their efforts, I will supply all the necessary men and funds." When it is considered that the funds available for the road construction program alone in the United States represent the expenditure of $1,000,000,000, the cost of the overhead organization, such as that of the National Research Council, to unify research, is insignificant. There is abundant money available for the research itself. The Advisory Board on Highway Research, of the National Research Council, is in a position to co-ordinate such expenditures in a comprehensive national program.

An informational service, giving the results of current studies and advances in the art, will be supplied to various cooperating bodies at frequent intervals.

The program for highway research will not be limited to problems concerned with the construction and maintenance of roads from the ordinary engineering standpoint. It will also consider those important problems of economics of transport upon highways in relation to other transport agencies, the relation of the design of vehicles to the character of road construction, and the important problems of administration involving traffic regulation, fees and maintenance.

This is the first effort seriously to attack the whole problem of highway transport. With the earnest desire of all interested to co-operate, the efforts of the National Research Council, seconded by Engineering Foundation and the national societies of engineers, should be effective.

WHAT AN EMPLOYER REQUIRES WHEN ENGAGING AN ENGINEER

By Frank D. Chase, of Frank D. Chase, Inc., Engineers, 645 North Michigan Ave., Chicago.

(Editor's Note: This very helpful talk, on a subject of vital interest to all engineers, was given by Mr. Chase at the Employment Conference held in Chicago under the auspices of the American Association of Engineers.)

The employer divides his resources into material and labor. Material in any form whatever is represented by capital or represents capital.

The inventory or list of assets of any firm take cognizance only of material as representing capital investment. The banker looks at the inventory before making his loan, corporations are financed on the inventory and all the plans of a going concern are based on inventory, or some form of material investment.

I have to speak briefly of the other of these two subdivisions of industry; that is, labor, and specifically of the engineer and of his being employed—in other words, I am to discuss what an employer requires when engaging an engineer.

It is quite true that material forms the basis of inventory or a value measure of a going concern, but an important although intangible thing is the element of labor. By labor I do not mean merely manual or physical effort—labor is defined as mental or physical activity.

It is quite true that the banker looks at the physical inventory when making his loan, but it is also true that without the consideration of labor, or personnel, the inventory does not go very far with the banker, nor does it go very far with the average business man; in other words, the labor or personnel of an establishment or institution is quite as important as the material element and frequently far exceeds it in importance.

The U. S. Steel Corporation, with its hundreds of millions of invested capital, would be a failure as a going concern without the guiding master mind of Judge Gary and his able subordinates who execute the policy of the corporation. Without the personnel who comprise the management of this corporation it would consist of merely an aggregation of large manufacturing plants, which might or might not produce profitably and which could not exist were it not for the intellectual labor which controls and executes.

The men, then, who execute and form the big part of the personnel of the organization must be considered as of the utmost importance and their selection carefully studied in order to secure a proper personnel.

The apprentice of today is the executive of tomorrow, and the necessity of care in the selection of men is recognized by the modern employer, regardless of the character of the position or its relative importance in the organization. The large corporations frequently make the same complete investigations and analysis in the employment of an office boy that is made in the selection of a ten-thousand-dollar man.

What I have said may be considered in the light of a generality, but it is not; I have merely stated a few fundamentals, and they apply with equal force to the employment of the engineer. This is particularly true in the light of present-day practice of using engineers or men of engineering training and some engineering experience in responsible positions in almost every line of industrial activity.

Realizing the importance of the proper personnel of an organization, the employer who does not formulate a very definite plan for the employment of his assistants is making a very serious mistake, and I shall outline briefly, from my own experience, what appears to me as being the important considerations.

It seems rather unscientific to speak of "hunches," but when I interview a man for employment it takes me considerably less time than it has taken me to say it to size up a man and place him. Subsequent conversation and data serve to corroborate or verify my first impression. The first size-up naturally separates itself into two divisions; first, the physical qualifications of the man; second, the mental qualifications. Physical qualifications should include good health, which is reflected by an upright, alert bearing, and personal appearance as indicated by clothing and the way it is worn. In 99 times out of a hundred, a man's physical appearance does indicate to a great measure his mental characteristics and qualifications and thereby reflects his personality, of which I shall speak later.

A man's mental attitude is reflected by the style of his greeting and one can determine a man's ability of presentation by the way he presents himself.

Characteristics which one notes are aggressiveness, tempered by good taste or breeding, straightforwardness, or clear or logical thinking which is exhibited by a man's ability to state his case briefly and without undue loquaciousness. His mental qualifications and mental capacity are indicated at the outset by these manifestations, all of which may be determined within a minute's time. The facts may then be brought out which are essential in any engineer, and these include:

First—Loyalty.
Second—Personality.
Third—Experience.
Fourth—Education.

I have outlined these four principal items in the order in which they appear to me as being essential and in this order can the facts be determined when employing a man. I place loyalty first. This word is susceptible of rather a broad interpretation and this is the interpretation I put upon it. Loyalty means loyalty or honesty of conviction or purpose, first, to one's self. If one is loyal to his own conviction of right he is loyal to his employer.

When I started out a few years ago as a cub engineer I took the attitude that I had no boss but my own conscience and ambition. It has been my experience ever since leaving college, and beginning as a rodman, that I have been in responsible charge of work without coming in contact personally with a boss. My first job, as I say, was a rodman. As a matter of fact, I had a small party of men in the field, and it was my pleasure, although not necessary, to report about once a week to the engineer in the division, comprising about 300 miles, outlining to him what I had done during the past week or so and what I proposed to do. The execution of that work was in my hands entirely—I could work all day, play all day, and nobody was the wiser, and it was strictly up to me. I was governed entirely by a sense of loyalty, and when I say loyalty to myself and my feeling that I had no boss, I mean it was simply up to me to make good for my own best interests, because therein lay the best interests of my employer. I figured that

if I made good for myself I was making good for my employer. Of course this is true—if I make good for my employer I make good for myself, but as an individualist I put it the other way around, and we are all individualists in the last analysis. We are all out for what we can get—nearly all of us with the thought of getting it honestly—some, and they are few fortunately, with the thought of getting it dishonestly.

Loyalty to one's self and one's employer means honest work, and its reward, promotion, increase of responsibility and salary—and the men who have the ambition to attain these are the men we are looking for.

The simple test for loyalty is to get the applicant to talk about his present or former employers—the man with a grievance should be watched, and the man who criticises his treatment and lack of opportunity is usually lacking in loyalty. I believe that it is the exception rather than the rule that a man fails to get proper consideration of his services and opportunities for advancement. Opportunities abound; the average man is waiting for the opportunity for advancement to be given him. It won't be, but he can, in a million ways, seize the opportunity and profit thereby.

My second classification is *personality*—rather difficult to define, but to me it means the expression, outwardly, of one's self. We speak of an agreeable, a strong, dominant or compelling, or an intelligent personality. All the knowledge in the world is of no avail if one cannot apply it and use it for the benefit of those whom he is paid to work with.

The right personality permits a man not only to do himself and his work justice, but to co-operate with his fellowmen, developing thereby teamwork—a vital necessity for the proper functioning of any organization.

A man's personality is reflected by his every act and speech, oral or written, and therefore can be observed at any and all times, and easily studied during an interview.

My third qualification is experience. I grant that without experience, loyalty and personality are without value, but mere experience is a drug on the market. There are too many men who can teach us the contents of all the engineering text-books in the library, and they call themselves engineers—I do not so consider them. It takes more than mere technical knowledge to earn the title engineer. For a given job, however, certain experience is essential, and it is an easy matter to determine whether or not an applicant fits, so far as experience goes. References as to experience and other capabilities are, in my opinion, of little value, and I place little value upon them. It is a rare occasion for me to condemn a man in such a way that I interfere with his chances for employment, and I believe that is true of most of us.

Experience is not always a matter of years—there again does personality enter, and one man's work for a year may better fit him for a similar line of work with greater responsibility than five years' work by another man.

Experience is a splendid, if somewhat costly, teacher, but the man of judgment learns rapidly.

Education is the last of my qualifications, and the least important. It's not what a man has learned, but what he knows, and his ability to apply his knowledge. By application I mean, for instance, the knowledge of where to find specific data—that's better than burdening the mind with masses of statistics which cannot be relied upon.

The college man has a splendid advantage, or a serious handicap, depending on how he makes use of his education. The man who digs out his education in a night school better appreciates what he has—he got it because he wanted it—not because it was handed to him. The percentage of successful correspondence or night school graduates is high, I imagine.

These four qualifications are all susceptible of record, and a record can be made of each, and many large corporations are giving keen study and analysis to the men whom they employ. These records are used not merely as an entrance requirement, but are the basis of transfer and promotion. In other words, the employment of men is being put on a scientific basis—a good job for the engineer.

In closing I want to say, without apology, that I have treated this subject briefly, but have, I believe, covered the essentials. The points discussed are, I believe, fundamental.

Whether you agree with me or not, I do not think there is much difference in the fundamental analysis required, whether we are employing engineers or street-sweepers.

It's a matter of common sense, which Professor Swain used to say should be called "uncommon sense"—it is so rare. Engineering is merely the application of common sense to a specific field of human

endeavor, and we want men, not automatons.

VALUABLE TRADE LITERATURE

Ladder Type Excavators.—Bulletin 25X is a new 16-page publication of the Pawling & Harnischfeger Co., of Milwaukee, describing P. & H. Ladder Type Excavators. Specifications and descriptions of all parts of these trench digging machines are included as well as many illustrations of work done and excavators in action on various jobs. Brief reference is also made to the new P. & H. "206" Excavator-Crane with full corduroy traction.

Shovel Attachment for Excavator Cranes.—The new P. & H. Shovel Attachment for use with standard P. & H. types 205 and 206 Excavator-Cranes is described in a Pamphlet SX just published by the Pawling & Harnischfeger Co., of Milwaukee. Illustrations of the shovel attachment in use are shown and the economy of being able to use either the 30-ft. crane boom or the shovel boom is pointed out. With the extra expense of only the shovel attachment, the number of applications of this material-handling and digging machine is increased—the shovel, it is said, having the ability to do the work of any steam shovel of equal weight.

Asphalt Mixing Plants.—The several types of asphalt mixing plants produced by the Iroquois Department of the Barber Asphalt Paving Co. are illustrated and described in a booklet recently issued by that company.

Waterproofing of Concrete.—The waterproofing of concrete is a subject on which there is not an over-abundance of information in textbooks. In Technical Pamphlet No. 8, The Truscon Laboratories of Detroit, Mich., an effort is made to supply a textbook on the fundamentals of this important subject. It has the advantage of brevity. It can be read in half an hour. The pamphlet will be sent free to any architect, engineer or builder so requesting.

What is Your Highway Problem?—A beautifully bound portfolio entitled, "What is Your Highway Problem," has just been issued by the Asphalt Sales Department of The Texas Company. This portfolio describes briefly and concisely, yet thoroughly, the steps in the construction of the various types of asphaltic pavements and roads. Each type of construction is thoroughly illustrated with photographs, and some of these photographs are supplemented by drawings and cross sections.

The types of asphaltic construction discussed are Sheet Asphalt, Asphaltic Concrete, Asphalt Macadam, Asphalt for Surface Treatment, Asphaltic Road Oils, Asphalt Filler, Asphalt Foundation, the use of Asphalt to Resurface Worn Block and to Resurface Cement Concrete. The portfolio begins with a description of Texaco Highway Service and concludes with a list of Texaco products and their various uses.

This booklet may be obtained free by addressing The Texas Company, Asphalt Sales Department, 17 Battery Place, New York City.

Modern Road Building and Maintenance.—This book has been prepared for the use of engineers, contractors, road officials, students and all who are interested in the rational and economic solution of the many problems connected with our public roads and traffic they are required to carry. The book was written by Andrew P. Anderson, Highway Engineer of the Bureau of Public Roads. It contains chapters on Planning the Road; Road Materials; Road Construction; Road Maintenance and Repair and Use of Explosives. A copy will be sent free to anyone making a written request to the Hercules Powder Company, Wilmington, Del.

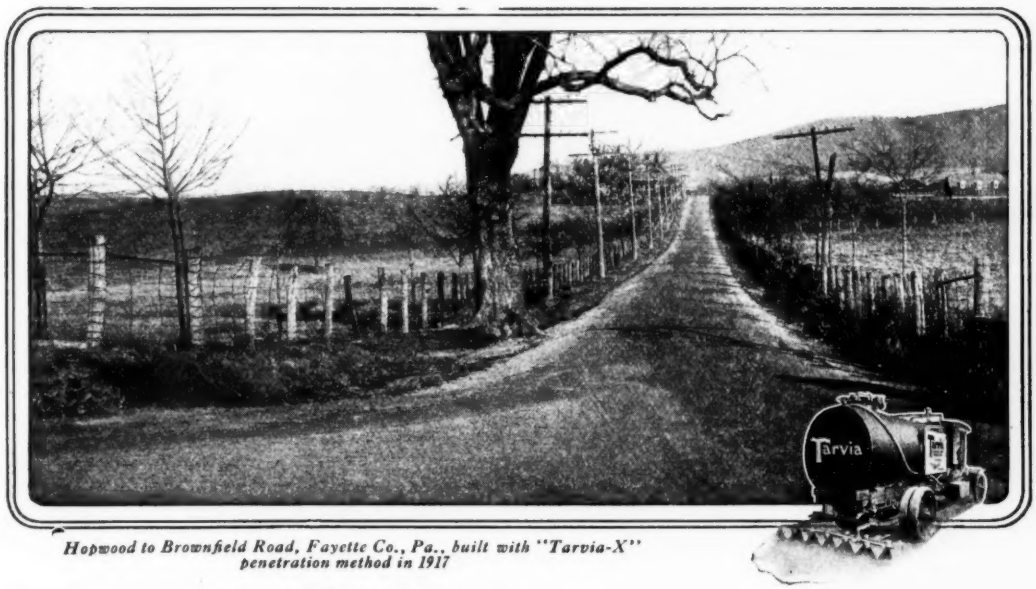
DETERMINATION OF BEARING POWER OF SUBGRADE UNDER REPEATED LOADS

By H. F. Clemmer, Testing Engineer, Illinois Division of Highways, State House, Springfield, Ill.

In an attempt to determine the action of the subgrade under hard-surfaced roads when subjected to repeated loads, such as would be caused by the movement of heavy vehicles on the surface, the Illinois Testing Laboratory has designed a new apparatus termed the Repeating Load Bearing Power Determinator.

It has been found that the pressures to which a subgrade under a hard-surfaced road is subjected, can be of three kinds, depending upon the way in which the load is applied to the surface. If the surface is rough or if a truck wheel hits an obstruction an impact force is produced, while if a truck stops for any appreciable length of time a static load is occasioned on the subgrade.

The action of the subgrade under these two classes of loads is being studied by use of the Goldbeck Impact Bearing Power Determinator and the Illinois Static Load Bearing Power Determinator.



Hopwood to Brownfield Road, Fayette Co., Pa., built with "Tarvia-X" penetration method in 1917

A substantial Slag Road built with Tarvia—

The photograph above shows a section of the Hopwood to Brownfield Road, South Union Township, Fayette County, Pa.

This road was built over an old water-bound base by the Township Supervisors with their own forces. A five-inch course of Dunbar Bank slag was used as road metal. The slag was bound with "Tarvia-X" applied by the penetration method. A deferred "Tarvia-B" seal coat was applied two months after completion.

This is now a mighty fine piece of road that is proof against heavy traffic. With occasional Tarvia maintenance, it will last for many years, forming a mudless, dustless, automobile-proof highway of which any community might well be proud.

This is just another example of the fact that no matter what sort of a road problem town or highway officials encounter, they can turn to Tarvia with the comfortable knowledge that there is a grade and a method of application of this versatile coal-tar preparation to help them out.

Illustrated booklets describing the various Tarvia treatments, free on request.

Tarvia
For Road Construction Repair and Maintenance

Special Service Department

This company has a corps of trained engineers and chemists who have given years of study to modern road problems. The advice of these men may be had for the asking by any one interested. If you will write to the nearest office regarding road problems and conditions in your vicinity, the matter will be given prompt attention.

New York, Detroit, Salt Lake City, Johnstown, Elizabeth, Chicago, New Orleans, Seattle, Lebanon, Buffalo, Philadelphia, Birmingham, Peoria, Youngstown, Baltimore, Boston, Kansas City, Atlanta, Toledo, Omaha

The Barrett Company

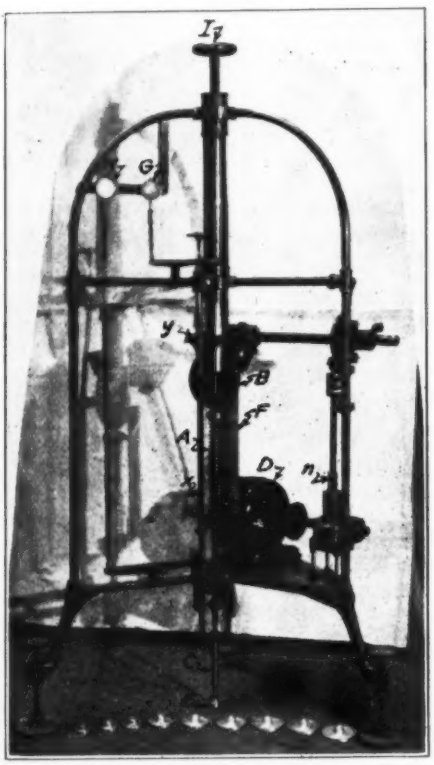
St. Louis, Minneapolis, Duluth, Columbus, Jacksonville, Cleveland, Dallas, Milwaukee, Richmond, Houston, Cincinnati, Nashville, Bangor, Latrobe, Denver, Pittsburgh, Syracuse, Washington, Bethlehem

THE BARRETT COMPANY, Limited: Montreal, Toronto, Winnipeg, Vancouver, St. John, N. B., Halifax, N. S.

The Illinois Repeating Load Bearing Power Determinator is being used for making a study of the subgrade when subjected to a third condition—that of a great number of vehicles passing over the surface. The first two devices allow a study of the subgrade when subjected to impact and static loads, while with the repeating load device the subgrade action can be noted when subjected to a load increasing from zero to a maximum and then back to zero again, in approximately the same time and of the same magnitude as would be occasioned by a heavy motor truck wheel moving over a rigid surface.

The Determinator

Briefly described, the Determinator, shown in the accompanying illustration, consists mainly of a pipe frame in which



VIEW OF ILLINOIS REPEATING LOAD BEARING POWER DETERMINATOR.

is mounted: a spring (A) for producing pressure; a cam (B) which varies this pressure; a plunger (C) which transmits this pressure to the soil; a 1/6-h.p. D.C. motor (D), which drives the cam at a constant speed of six revolutions per minute; a footing (E) which is attached to the bottom of the plunger and distributes the pressure to the soil (footings of different areas are shown at the bottom of the machine in the illustration); a scale (F) upon which the pressure desired is set; an Ames dial (H) which registers the action of the soil under the repeating loads; a wheel (I) which lowers the cam section, and a second Ames dial (G) which registers the vertical movement of this section. Motor power is furnished by a power unit carried on the truck which transports the Demonstrator.

Action of the Apparatus

The machine is leveled up so that the plane of the footing on the bottom of the plunger is parallel with the surface of the soil. By means of loosening setscrew (n) and applying a crank to shaft leading to the cam, the pointer on the upper end of the spring is set approximately to the pressure desired. Fine adjustment of the pressure can be made by turning the lower bearing upon which the spring rests. Setscrew (n) is then tightened and the power unit attached. The motor, in causing the cam to revolve, varies the pressure on the soil from zero to a maximum and then back to zero six times per minute. As the soil is deflected under the pressure applied, it is necessary to lower the cam section in order that the pressure remain constant. This lowering movement is accomplished by turning wheel (I), and is registered on dial (G). Dial (H) registers to the 10,000th part of an inch the action of the soil beneath the footing.

In order that the soil might be permitted to recover from the pressure without being opposed by the dead load of the plunger-section, it was necessary to design an attachment which would carry this load immediately after the pressure was released. A shaft (x) and a countercam (y) were attached to the frame to pick up this load and carry it until just before the pressure was again applied.

Variable sized footings are being used in order to get some relationship between the action of soil under loads applied to different areas. The loads applied to these footings vary between 5 and 50 lbs. per square inch.

This apparatus is at present being used in the subgrade investigational work carried on in connection with the Bates Experimental Road. With the co-operation of the U. S. Bureau of Public Roads an attempt is being made to correlate the results obtained in the field with the soil-bearing power values as indicated by the experiments carried on in the laboratory at Washington.

WATER WORKS SECTION

SWIMMING POOL OF THE LOUISVILLE WATER COMPANY, LOUISVILLE, KY.

By James B. Wilson, Chief Engineer and Superintendent, Louisville Water Co., Louisville, Ky.

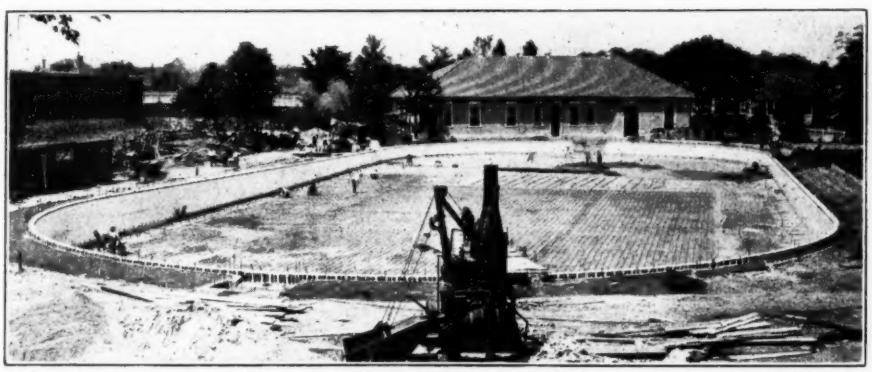
Realizing the growing popularity of swimming, not only as a sport and recreation, but the interest of the public in the necessity of learning to swim, the Louisville Water Company conceived the idea of building a pool and bath house on their property at the Crescent Hill Reservoir Park for the general use of the citizens of Louisville. Plans were developed during the winter months and a contract let April 1, 1919, for the lump sum of $93,000. The pool was completed and opened to the public July 25, 1919, at a total cost of $115,000.

The works consist of a bath house 60x125 ft., constructed of hollow tile walls, stuccoed; cement floor; steel roof trusses and tile roof, and a swimming pool, rectangular in shape, with rounded ends, 120 ft. wide by 275 ft. long. For a distance of 60 ft. at the shallow end the water is 3 ft. 6 in. deep and slopes uniformly over the entire width of the pool to the deep end, where the water is 8 ft. deep. Around the entire pool are two concrete walkways, each 6 ft. wide; one for the swimmers, the other for the spectators, and separated by two lines of 3-in. pipe railing with 8-in. concrete posts on 6-ft. centers.

The walls of the pool were designed as cantilevers on spread footings and reinforced both horizontally and vertically. There is sufficient horizontal steel in the walls safely to take care of a change in temperature of 120 degrees, and no cracking has developed. The concrete was waterproofed with integral waterproofing and is entirely watertight.

INTERIOR OF BATH HOUSE AT THE SWIMMING POOL OF THE LOUISVILLE WATER CO.

The conspicuous feature of the design is the bottom of the pool, which is a solid slab of concrete 8 ins. thick and reinforced with ½ in. square rods, 12 ins. center to center. The bottom was poured in one operation. Where the bottom joins



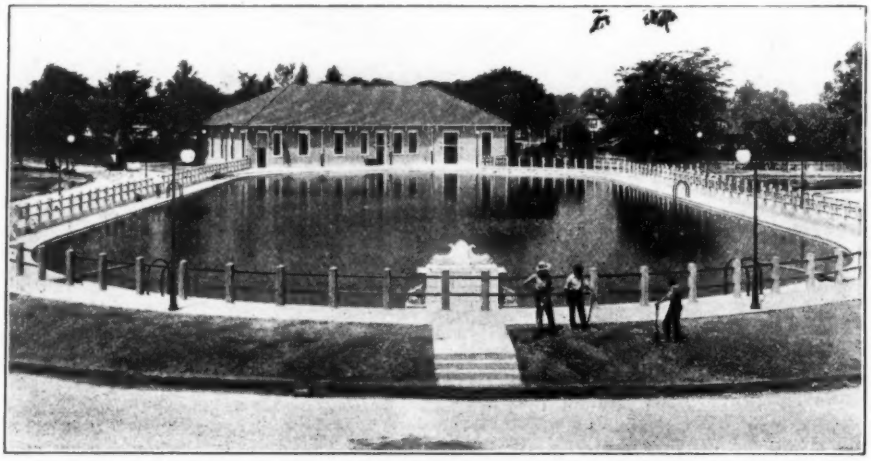
CONSTRUCTION VIEW OF CONCRETE SWIMMING POOL BUILT BY LOUISVILLE WATER CO.

the vertical walls of the pool a 1-in. expansion joint was filled with asphaltum around its entire periphery. With this exception there are no expansion joints in the structure.

The pool was built in a swamp which at one time had been a small lake, so that securing good foundations was difficult. The bottom slab of the pool, however, was laid on soft mud taken from the old lake excavation. While there is considerable difference in pressure on the bottom due to the depth of the water, there has been no settlement and the entire pool is watertight. The bottom of the pool was float finished and the sides hung on coat hangers placed in paper bags. The keys for lockers are kept in the check rooms and an attendant opens and closes all lockers. By this method few articles of clothing are lost and little confusion exists. All valuables and money are checked in the general lobby before entering the bath rooms.

As many as 1,800 have been in the pool at one time and the average attendance was approximated at 2,200 per day. The general admission is 25c for adults and 15c for children. This charge includes bathing suit, soap and bath towel.

Four maids are on constant duty in the women's dressing rooms; in the men's



VIEW OF THE FINISHED CONCRETE SWIMMING POOL, LOUISVILLE WATER CO.

covered with white enameled brick, including enameled terra cotta life rail at the top. The water level of the pool is maintained within 6 ins. of the sidewalk around the pool.

No provision was made for taking off the surface water at intervals around the edge of the pool. The water enters at one end and flows to the opposite, where it is discharged through eight openings in the life rail into a small lake 6 ft. below. Daily tests were run of the pool water, in the laboratories of the Water Company, and at no time was the water found unsafe for drinking purposes. This was controlled by increasing the water supply to the pool and varied from 250,000 gals. to 750,000 gals. per day. The entire pool holds 1,200,000 gals.

Dressing rooms are arranged on each side of a general lobby for men and women. One thousand lockers are provided for the men and 600 for the women, and supplemented with two check rooms where clothes are checked after being dressing rooms and showers there are six attendants, including two janitors. On the pool are six life guards who are on duty from the opening till the closing hours of the pool; that is, from 10 a. m. to 10 p. m.

PUBLIC WATER SUPPLIES FROM SMALL STREAMS

By James P. Wells, Hydraulic Engineer, Cutler Bldg., Rochester, N. Y.

The construction of storage reservoirs has largely been in connection with hydraulic works of considerable magnitude. Nearly everyone is familiar with the large storage reservoirs recently constructed by the city of New York and other large cities of the country, yet not enough attention has been paid to the possibilities of obtaining in the same way adequate supplies of water for small cities.

There are many small cities of from five to fifty thousand people in population which could obtain a much more econom-

ical and better supply of water than they now get by pumping water, by the construction of reservoirs on small streams and by making these reservoirs large enough to conserve practically the entire runoff of the stream.

The writer has been asked on a number of occasions to make some suggestions as to improving the water supplies of such cities, and has in several cases found that it was entirely possible to get a very economical gravity supply from small streams which were practically dry during the summer months. While they were dry in the summer months, yet in the spring of the year they were for a very short period raging torrents, and the writer knows of several instances where sufficient water has passed down a stream with a very small watershed in three or four days completely to fill a large reservoir. These streams have never been considered or never thought as possible sources of water supply because of the extreme low water conditions during the summer months.

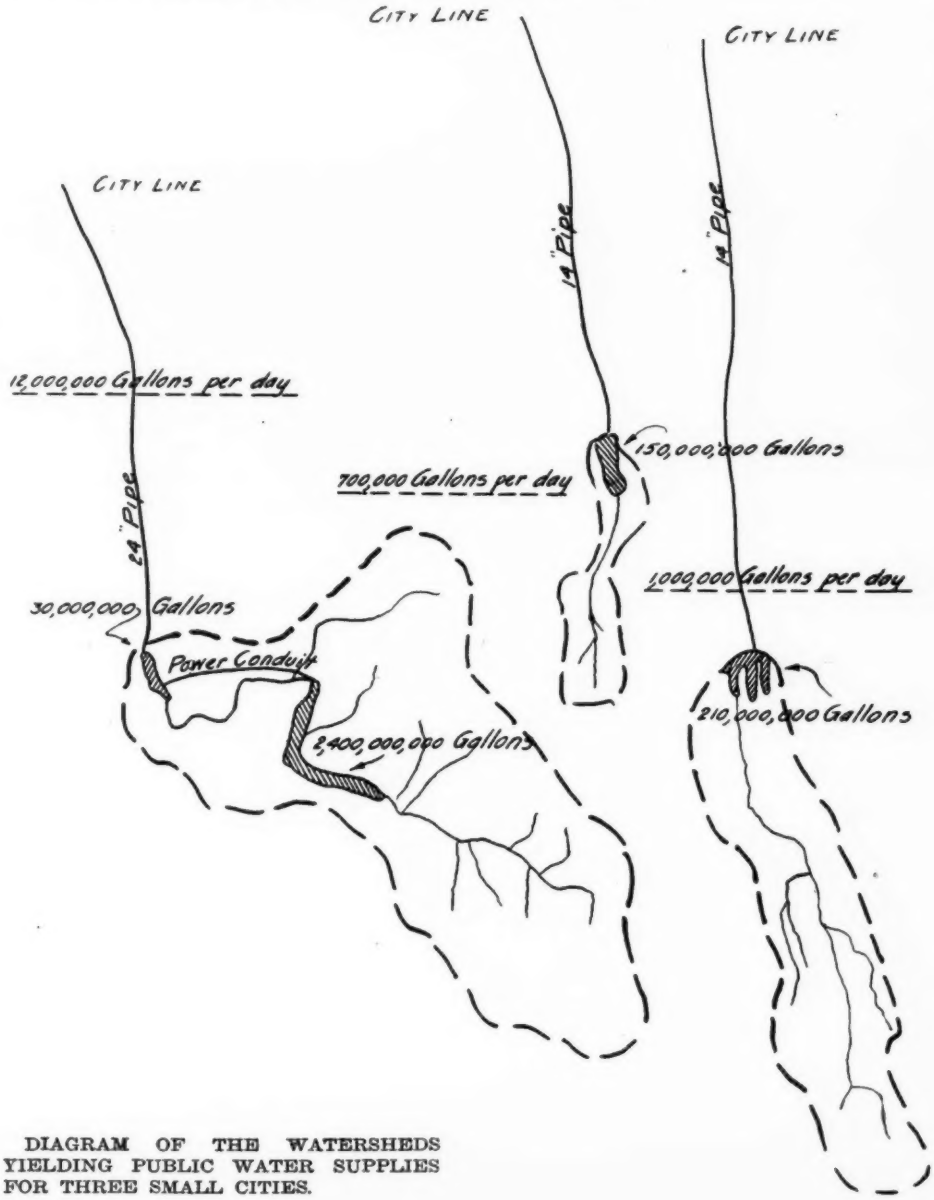


DIAGRAM OF THE WATERSHEDS YIELDING PUBLIC WATER SUPPLIES FOR THREE SMALL CITIES.

The accompanying diagram shows the watersheds of two such supplies, for which the writer prepared plans, which have been built and are in successful operation, also another supply for which plans are under way. An adequate supply created in such a manner, that is by the construction of a very large storage reservoir, will never fail to provide a sufficient quantity of water, if there is sufficient watershed and the reservoir is large enough. The size of the watershed can generally be determined from existing maps, and the runoff of the stream from the records of stream flow either on the stream under consideration or upon some adjacent watershed, with due consideration for the different conditions existing on the respective watersheds.

The smallest of the watersheds shown in the diagram is only one and one-half square miles. The size of the reservoir is 150 million gallons. This reservoir has produced practically complete regulation of the stream and will provide continuously even in an extreme low year a flow of 7000,000 gals. per day. In this particular case the stream supplying the reservoir is in some years totally dry for a period of six months. It is the flood flow which fills the reservoir.

The largest watershed, that of 17 square miles, will provide 12 million gallons of water a day. In that case the storage is 2,400,000,000 gals. Some hydro-electric power will also be developed in connection with this project. In all cases the water furnished to the cities has been of the very highest quality. In cases where there are dwellings on the watershed the writer has provided for filtration plants, to be absolutely sure of no contamination.

In those cities where the problem of a good water supply is a serious one, and where the supply is obtained by pumping water at a large annual cost, it will be well worth while for the city officials to investigate possible gravity supplies from storage reservoirs, even though these have never been previously suggested or considered.

SOME EXPERIENCES IN THE DEVELOPMENT OF THE OIL ENGINE

By F. B. Leopold, Vice President, Pittsburgh Filter and Engineering Co., Farmers' Bank Bldg., Pittsburgh, Pa.

I will try to give some of the things I have learned in the course of a year and a half contact with the development of the internal combustion heavy oil engine, said Mr. Leopold in addressing the 1921 convention of the American Water Works Association.

Historical Notes

I might say in starting that it is generally recognized that Dr. Diesel, a German engineer, is looked upon as the father of the internal combustion engine using heavy oil, and his original patent is dated 1892, although there were various attempts made in the line of development for many years previous to that time.

According to historical records there was actually built an engine in 1680. This engine, however, did not prove a success, but was probably the first step in its development.

In 1791, an Englishman, John Barber, built an engine made to use gas distilled from coal, and from that time on to 1866, when Otto Diesel obtained his first patent, there were several attempts made. Diesel, however, was undoubtedly the father of the present successfully developed engine, and, although his first patents were obtained in 1892, it was not until 1898 that a commercial engine was produced.

In 1898 Mr. Adolphus Busch became interested in this engine, and secured the rights for the United States. The first engine built being a 60 h. p. engine. During the first few years, however, the progress was very slow, and the results unsatisfactory. It is really only in the last ten or twelve years that this type of engine has come into its own in European countries, and is just beginning to be recognized as the coming power unit in this country. It is altogether probable that the abnormal increase in the price of coal, caused by the war conditions, was the greatest single element in arousing interest in the heavy oil engine, and has made for a tremendous impetus in its development.

Number of Builders

Up to five years ago there were probably not to exceed four or five concerns in this country building internal combustion engines, using heavy oil as their fuel. At the present time there are 16 builders of Diesel engines and 35 establishments building various types of so-called semi-Diesel, or low compression heavy oil engines. Some of them have been on the market for a number of years, and are now turning out engines in large quantities, operating with great success. Others are in various stages of development work.

Among the main successful builders of

the Diesel type of engine are the Busch-Sullzer Co., who were the first to engage in this work; McIntosh & Seymour Co., William Graff & Sons, New York Ship Building Co., and others who are building engines ranging from 200 h. p. to as high as 2,000 h. p. each.

Of the builders of the semi-Diesel type, the oldest concerns in the development of this work are the August Mietz Corporation, Fairbanks Morse Co., Bessemer Manufacturing Co., the Burnoil Engine Co., and St. Marys Engine Co. Of the 35 concerns building the so-called semi-Diesel engine, 12 are operating under the Hvid-Bronz patents, and this is the type of engine that the writer has had such experience with as he possesses.

The Hvid-Bronz Type

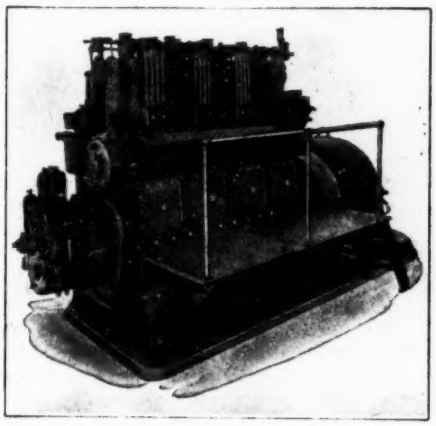
This type of engine is different in its principles of operation from either the Diesel or the semi-Diesel. The essential features of difference are in the method of supplying the fuel. In all cases the fuel is ignited by the heat of compression, but the method of starting and applying the fuel to the various types is essentially different. In the full Diesel the fuel is applied with a pump at extremely high pressure, through a needle valve, through which the fuel is forced by an air pressure varying from 800 to 1,000 lbs., which breaks it up into fine particles, so that when the heat of compression is applied it is completely consumed.

In the semi-Diesel, so-called, the fuel is dropped onto a pan or bulb which is heated. The fuel is vaporized by the heat. After the engine is started this bulb is maintained at a high temperature by the heat of compression sufficient continuously to vaporize the fuel, but in starting it often requires from ten minutes to half an hour to heat the bulb by a torch sufficiently so that the fuel might be vaporized when coming in contact with it.

The Hvid-Bronz type of engine, with which our experience was connected, draws the fuel into the cylinder on the suction stroke of the engine, or rather it draws it through a small valve into a cup. The compression stroke then heats up this cup and generates a pressure inside of the cup, which blows the fuel out and atomizes it into the cylinder, when it is ignited. The semi-Diesel engines operate on a lower compression pressure, but are not as economical in fuel consumption as the Bronz-Hvid or Diesel type.

The writer became interested in this proposition by reason of having become interested in a shop, which at the time was manufacturing material for war purposes, and it became essential to find some product for permanent development. In looking over the field, the future of the oil engine seemed extremely promising, and it is the writer's belief that this industry is just in its infancy.

The great advantages of this type of motor for both stationary and marine purposes is so obvious that temporary discouragement can not hold back its development. On the other hand, there are many problems to be solved. Those, apparently, who have given it the greatest technical and practical study of many years, find difficulties which they are unable to foresee, and which, while small in themselves, are of the most vital importance in the successful operation of the engine.



FRONT VIEW OF FOUR-CYLINDER 100 H. P. PITTSBURGH HEAVY DUTY OIL ENGINE.

The illustration given here of a four-cylinder engine is the first engine built by us, and the design of the completed engine is exactly as it was on the drawing board, as far as all outward appearances are concerned. All the changes that have been made in the development and experimental work have been entirely on the method of applying the fuel to secure the determined calculated exact distribution and consumption, which means success in the operation, and efficiency of the completed machine.

Preliminary Investigations

In our preliminary investigations in the oil engine field, after reaching a determination that this was a promising busi-

ness for development, the writer, in connection with our engineers, looked over many different types of engines that were being developed and being built. We secured the services of an engineer who had had many years' experience, both in European and American practice, in the design of Diesel engines, and who I believe is today one of the best oil engine engineers in the country.

We were desirous of looking into the future possibilities, and while up to that time the hot bulb or low compression type of engine was most favorably known, and had been built and used to greater extent than any other type of heavy oil engine in this country, we finally concluded that on account of its higher economy and apparently more satisfactory operation that the Hvid-Bronz type of engine had the greater future promise.

This engine is comparatively new, but had been built by one concern for about three years previously, and by one or two others for a shorter period and had been marketed in considerable quantity, and as far as we could learn was giving a very satisfactory account of itself.

Most of these engines were built in small single cylinder units, although one concern was building a vertical multiple-unit engine, which seemed to be fairly satisfactory. Several others were developing a multiple cylinder engine of this type. We, therefore, after a thorough canvass of the field, decided on a Bronz-Hvid type of engine of this multiple cylinder type, and it was our desire and intention to build the highest class engine of this type that could be built.

Initial Experiments

In our initial experiments and investigations, we purchased a small single cylinder engine of five or six horse power, and made a very long series of experiments with this engine, with results that were absolutely convincing, and although our engineer felt it was far from being perfected, the operation of it was entirely satisfactory from a practical standpoint. This engine would operate on practically any kind of fuel oil that would flow in it, and in fact in our experiments we attached four or five different fuel vessels to the supply line to the engine, ranging from kerosene of the highest grade to the heaviest of crude oil, and it operated apparently equally well on any of them; in fact we would often switch from one oil to the other during the period of operation.

This engine has no carburetors or electric spark plugs, nothing at all but the compression heat generated in the cylinders to ignite the fuel. The simplicity of its construction and operation was the appealing feature.

Our investigation work was cleared up during the war period and the engine completely designed, but no work accomplished until after the close of the war. The patterns were made and the engines built completely in accordance with the designs and not a single change was made in its construction, as far as the general features were concerned. On its completion the engine was started in operation and was, apparently, a completed piece of mechanism. During this period we had the co-operation and advice of the patentee, and on the day of completion, when we were ready to place it on the test block for operation, he was more than pleased with the way it started. As the writer had never seen an engine start before on the testing block, he was, naturally, very much elated, as, apparently, it was going to go right, from the start, and we were ready to do business and take orders.

However, it was more than a year later before our engineers were ready to place the seal of their approval upon this engine, and during that period we spent many anxious days and nights in endeavoring to determine just what was required to make a successful machine out of it.

The Fuel Feed Difficulty

The principal difficulty, in fact the only difficulty, was apparently the inability properly to supply the fuel, so that a complete combustion could be secured, and in the initial run, although we had followed fully as we felt the instructions and directions and formulae given us by the patentee, the exhaust discharge was a black column of smoke that might be seen for miles, and at night this was superseded by a continual spurt of flame.

It did not require much knowledge of engineering to comprehend that this condition would not allow of operation for a very extended period of time, and in fact a few hours operation found the fuel cups completely clogged with carbon. Then began our real work, and this dragged over a period of approximately a year.

During this period of time we had many engineers visiting our works and offering suggestions, many who seemed to think that our troubles were trivial and might be corrected in a few days' investigation.

The inventor himself, or patentee rather, laughed them away. However, the difficulties were multiplied by the number of cylinders, and the class of machine which we desired to build.

We discovered that there was a vast difference between building an engine of a single cylinder which would be satisfactory for ordinary power purposes, or the small factory, oil well or farm, and building a multiple cylinder engine for a continuous 24-hour service, where the greatest nicety of speed regulation was required, and where the possibilities of the engine being out of service at any time, might be reduced to a minimum.

The introduction of the fuel into a single-cylinder engine was a comparatively simple proposition. The introduction of an equal amount of fuel into each cylinder of a multiple-cylinder engine, to maintain the same amount of work on each cylinder and thereby maintain uniformity of speed and power, was a very complicated proposition. We, very often, found that we would get practically perfect combustion in one cylinder, and in the next cylinder we were unable to operate for any length of time without completely filling with carbon.

Many and various were the methods we used for equal distribution of the fuel to the cylinders, for the principal of the Hvid engine is a gravity feed, the fuel being taken into the cylinder on the suction stroke of the engine. We found that with a multiplicity of cylinders the fuel charge would vary in each cylinder in this manner, and we finally abandoned this method, as it was impossible to get a sufficiently equal charge necessary to secure regulation.

We started pumping the fuel against the compression stroke on a somewhat modified principle from the Diesel, and we tried a hundred other methods. In the end we used a pump that is practically a measuring device, but using a separate pump for each cylinder, which delivers the oil charge equally to each cylinder valve. It is then drawn in the cylinder on the suction stroke of the engine.

We discovered that there was an absolute and definite ratio of the size cups to be used, and the holes through which the fuel was discharged from the cups into the cylinder, and that these ratios would vary somewhat with different characters of fuel, and the very slightest variation from the determined areas, either of the cups or the holes, or the location of the holes, would affect the operation of the engine to a great extent.

The Fuel Cups

It was only, however, after experimenting with hundreds of different sizes of cups, and methods of adjustment, that we finally arrived at a definite formula for making these fuel cups, together with the sizes of holes they contain.

During the period while our engineers were making these various experiments, the writer became vitally interested in determining whether our experience was at variance to any great extent from others in this line of endeavor.

I found that other engine builders whom we had visited in our preliminary investigations, and who I had supposed were building marketable engines from the start, had gone through the same grievous experience, in fact, that some had spent thousands of dollars where we had spent hundreds. I found that several concerns, after spending upwards of a million dollars experimenting on the problems, trying to work out a successful engine, had finally been compelled to abandon it. Others had kept on until they had surmounted all difficulties and are now reaping the harvest, and will in the end have their money returned to them many times over.

The only satisfaction that I have been able to derive from this phase of the matter is that we were able, finally, to produce an engine which has been pronounced the finest engine that has been produced in this country of the Bronz-Hvid type, and I have no doubt that many concerns entering this field have brilliant prospects of future returns from the money that they may invest. I would, however, warn any one from entering this work with the idea that they will design an engine, even on well known principles, and expect it to be a success from the start, unless they simply reproduce the patterns in detail of some engine that is already on the market. This means that they must provide a large sum that can, if necessary, be devoted to the carrying of development work to a successful issue.

The possibilities of a heavy oil engine are limitless. In addition to the ordinary uses for central power stations, electric light plants, driving pumping units and general power purposes for marine work, all of which require, of course, units of fair size, there is untouched the vast use for the automobile, truck and locomotive.

Advantages of the Oil Engine

The actual cost of producing a horse power of work with the Diesel engine is about one-third the cost of producing in a steam engine. The initial cost of a power plant for stationary purposes, considering the cost of building, land, boiler and engine, would be practically the same. There are, however, many situations where the space occupied by a steam plant is unavailable. An oil engine will take up on an average from one-half to three-fourths of the same space that a steam engine would occupy, with the entire saving of space occupied by boilers, accessories and coal storage. The oil may be stored in a tank under ground and the space required for it need receive no consideration whatever, ordinarily.

The oil engine of the Bronz-Hvid type can be started instantly and stopped when you are through with the operation. The steam engine requires time to get up steam, and the first must be kept ready for service continuously. For marine work the space occupied in a ship, and the weight of the plant is very much less, giving the same size vessel the additional cargo space, as well as economy in operation. This is being realized very rapidly in marine service, and many ships are now being fitted with this type of motor.

Marine Uses of Oil Engines

In 1914 there were probably not to exceed 20 motor ships, as ships driven by oil engines are known. Today there are upwards of 500, and every day sees additions thereto, many vessels of ten to twelve thousand tons.

In the April issue of the "Motorship" is given an account of the operation of 7,500 motor ship "Borgland," totalling 95,000 miles, and nearly two and one-half years time without a stop on account of engine trouble. The writer states that "It is a somewhat ironical circumstance that one of the first cargoes that the Borgland carried was a load of 7,290 tons of coal from Norfolk, Va., to San Francisco, Cal." Also "preference among officers of the merchant marine for motor ships is significant, and in conversation with the 'Borgland's' captain he remarked that the motor ship is far ahead of any vessel driven by steam machinery, from the point of view of reliability, and referred to the fact that should one cylinder of the plant of an ordinary twin-screw Diesel engine give out, it is a comparatively simple proposition to put the cylinder out of action and carry on with the remainder at reduced speed, which is so inconsiderable as to be negligible. As regards fuel tanks the bulk of the oil is carried in four double bottoms, holding about 900 tons of oil. The fuel consumption is about seven tons per day, under normal conditions. It will thus be seen that the ship has a range of nearly 130 days without rebunkering."

As the average speed of this vessel is given at 10 knots per hour, it will thus be seen that she carries enough fuel to travel 31,200 knots, or 35,900 miles, or completely around the world, and nearly one-half the distance further. To do this with coal would leave little cargo space.

For steam plants, electric plants or pumping plants that are isolated from the coal fields, what a wonderful proposition it will be.

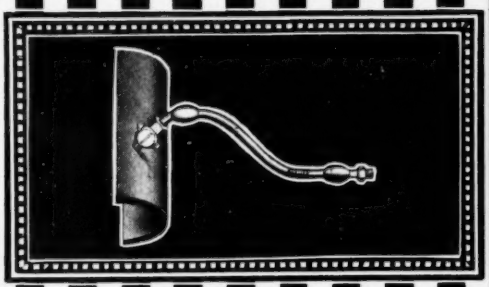
An oil engine will develop a horse power on one-half a pound of fuel oil per hour. A boiler requires four pounds of coal per hour, and some water works pumping plants require twice that much. This means from one-eighth to one-twentieth the weight of fuel to provide for.

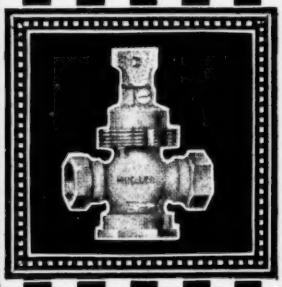
In times such as we have gone through in the past two or three years, what a strain off the minds of many plant engineers it would be to know that their storage capacity for fuel might be multipled many times in less space than is now available.

While this type of engine has not been developed successfully to take the place of the gasoline motor for automobiles, many engineers are working to this end, and it is but a question of time before it is accomplished. Considering the number of automobiles in the country, what a wonderful opportunity there is for the development of this type of motor to replace the gas motor for this work, doing away with electric spark plugs, carburetors and all the troubles attendant thereto.

There is also the railway locomotive and this phase is now being considered, I know, by one of the largest locomotive builders in the country, who has for the last year or more been studying the possibilities of this engine as a motive power for railroad locomotives, and undoubtedly the time is not far distant when we shall see it in use.

Tables I, II and III are given by Mr. Herbert Hass, in a paper issued by the Department of Interior, Bureau of Mines, Bulletin No. 166. This bulletin contains some very interesting information on this type of engine, and I would recommend





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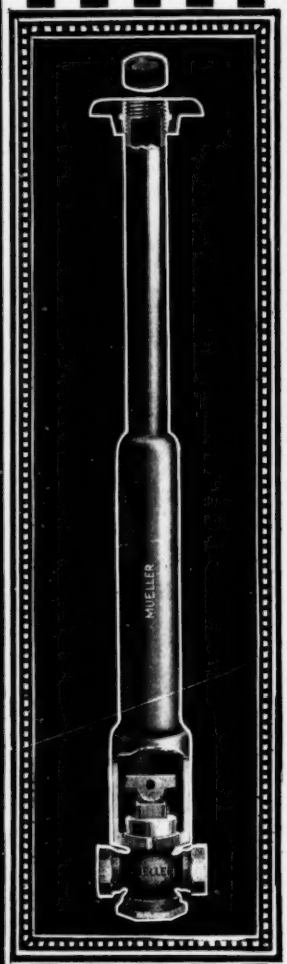

TABLE I—HEAT CONSUMPTION AND THERMAL EFFICIENCIES OF DIFFERENT TYPES OF PRIME MOVERS AT CONTINUOUS FULL LOAD.

Type of prime mover.	Heat consumption per brake H.P. hr. B. t. u.	Over-all thermal efficiency	Superiority of diesel engine. a
Noncondensing steam engine. b	40,000-28,000	6.30- 9.1	5.6 -3.6
Condensing steam engine using superheated steam. b	28,000-16,500	9.1 -15.4	3.6 -2.3
Locomobile engine with superheated steam and reheater, condensing. b	17,000-15,200	14.9 -16.7	2.4 -2.1
Steam turbine, superheated steam 200 to 2,000 H.P. b	24,000-15,500	10.6 -16.2	3.2 -2.2
Steam turbine, superheated steam, 2,000 to 10,000 H.P. b	15,500-14,000	16.2 -18.1	2.2 -1.95
Gas engine without producer	10,400- 9,300	24.4 -27.5	1.33-1.28
Suction gas engine. c	14,000-11,200	18.1 -22.7	1.95-1.55
Diesel engine	8,000- 7,200	32. -35.3	.....

a. Figures in this column are to be used as factors with which to multiply values in preceding column.
b. Figures include boiler losses.
c. Figures include producer losses.

COMPARATIVE COST DATA

Table II, following, presents fuel-cost data covering the operation of the prime movers represented in Table I.

TABLE II.—COMPARATIVE OPERATING COSTS OF DIFFERENT TYPES OF PRIME MOVERS.

Type of prime mover.	Kind of fuel	Average cost per 1,000,000 B.t.u. Cents	Cost of 1,000,000 B. t. u. effective work Cents	Heat cost per one effective H.P. hour Cents
Noncondensing steam engine. a	Coal	12	191-132	0.48-0.34
Condensing steam engine using superheated steam. a	Coal	12	132- 78	.34- .20
Locomobile engine with superheated steam and reheater, condensing. a	Coal	12	81- 72	.21- .18
Steam turbine, superheated steam, 200 to 2,000 H. P. a	Coal & anthracite	12	113- 74	.29- .19
		11	104- 68	.27- .17
Steam turbine, superheated steam, 2,000 to 10,000 H.P. a	Coal & anthracite	12	74- 67	.19- .19
		11	68- 61	.17- .155
	Natural gas, coke-	15	62- 55	.16- .14
Gas engine without producer	oven, gas or furnace gas	7	27-	7.
Suction gas engine. b	Anthracite	11	61- 49	.16- .14
Diesel engine	Petroleum	15-18	56- 43	.14- .11

a. Figures include boiler losses. b. Figures include producer losses.

COST OF FUEL.

Cost data covering the various types of fuel used in the prime movers represented in Tables I and II are presented in Table III.

TABLE III.—COST OF VARIOUS TYPES OF FUEL.

Kind of fuel. Price of fuel.	Heating value per pound B. t. u.	Absolute heat cost per 1,000,000 B. t. u. Cents	Average heat cost per 1,000,000 B.t. u. Cents
Lignite, $1.00 to $2.50 ton of 2,000 lbs	5,000- 9,000	10 -14	15
Bituminous coal, $2.00 to $4.00 ton of 2,000 lbs	11,000-14,200	9 -14	12
Anthracite, $2.50 to $4.00 ton of 2,000 lbs	14,500	8.6-13.8	11
Fuel oil (petroleum), 75c to $2.25 barrel	18,000-19,000	12.5-37.5	15-18
Natural gas, .10 to .75 1,000 cu. ft	900- 1,000	11 -75	15
Blast furnace gas, .05 to .01 1,000 cu. ft	90	5.5-11	7
Coke-oven gas, .02 to .05 1,000 cu. ft	450	4.4-11	7

Data regarding amount of work performed by different types of pumping equipment.

Type of pumping plant.	Work performed in lifting water Foots-pounds per 1 B. t. u.	Over-all efficiency Percent.
Steam; good operating conditions	54.5	7
Steam; best operating conditions	77.8	10
Steam; superheated steam used	93.4	12
Suction gas engine; good operating conditions	116.7	15
Suction gas engine; special conditions	147.8	19
Humphreys gas pump; special conditions	171.3	22
Humphreys gas pump; good operating conditions	156	20.1
Diesel engine; good operating conditions	225.6	29

it to anybody who is interested in securing real information as to what may be accomplished with the oil engine.

I have tried to give in a brief general way, without getting beyond my depth, some slight idea of the heavy oil engine, its development and possibilities as a power unit. What little knowledge we

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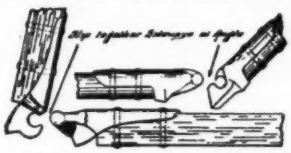

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have, has been acquired at a very considerable cost, and while I am just as thoroughly satisfied now as I was in the beginning that any successful engine of this type will return splendid profits on any investment involved, I also know that there is much still to be learned, and I would advise anyone who may be considering this field, either to acquire something that is completed, or be prepared to spend a fair sized fortune before expecting to see clear sailing ahead.

TREATMENT OF SWIMMING POOL WATER

By G. R. Shaw, Manager of R. U. V. Dept., James B. Clow & Sons, 534 S. Franklin St., Chicago, Ill.

The swimming pool is becoming so generally popular for schools, clubs and municipalities that a great deal of attention and study is being given to methods that may be used to keep the water of the pool in a sanitary condition so that it will not be a menace to the bathers. The very great danger with a swimming pool is that contamination of the water starts immediately the first bather enters and this contamination tends to increase with the subsequent use unless some positive method is provided to eliminate the dangerous pollution.

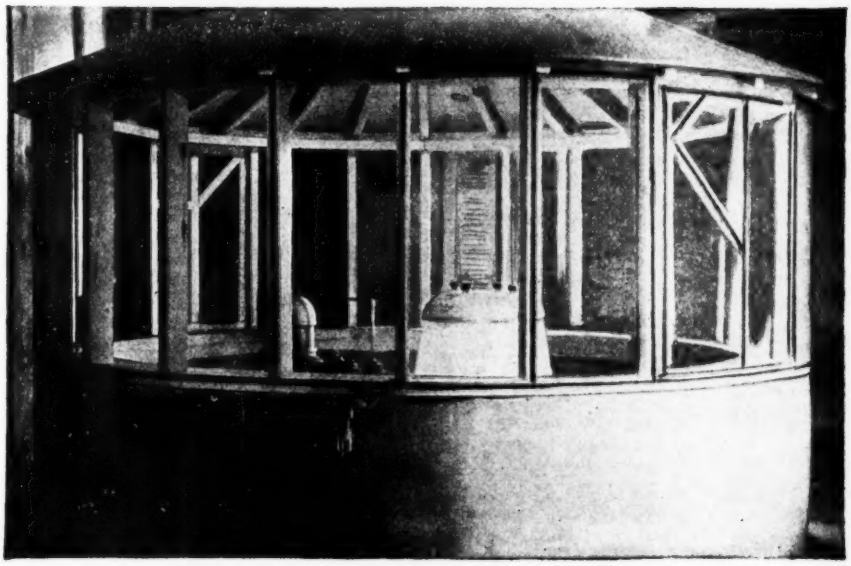
Studies and practical tests have shown that the most efficient method for eliminating the pathogenic bacteria is by the use of an Ultra Violet Ray Sterilizer on the circulating line in connection with a sand filter. The Ultra Violet Ray Sterilizer is, briefly, a water compartment through which is placed a mercury vapor quartz lamp so arranged that the water in its passage through the compartment is forced to flow around the lamp and is always exposed to the ultra violet rays produced in great intensity by the lamp. For some unknown reason the ultra violet rays, which are invisible and of extremely short wave length, are very detrimental to germ-life and exposure of any water borne bacteria to them results in the complete elimination not only of the pathogenic, or disease producing, bacteria but of the spore-formers as well. This is accomplished without in any way changing the taste, odor, color, temperature, chemical or mineral composition of the water treated and has the added advantage that there is no danger of overdosing the water, rendering it objectionable to the taste, or of underdosing it, resulting in all bacteria not being eliminated. If the water flows through the sterilizer within its rated capacity complete sterilization of the water will result.

The treatment of swimming pool waters is very necessary, as it is impossible for any bather to enter the pool without taking some water into the system. When it is considered that the average swimming pool is cared for entirely by an untrained attendant so that it is impossible for the condition of the water to be definitely known at all times, it is realized that the only safe method of treatment is by some automatic and positive means which will result in only a water free from all dangerous bacteria being introduced into the pool at all times. This is assured with the Ultra Violet Ray Sterilizer installed on the circulating line.

It has been found that the ultra violet ray process has the further advantage of imparting some property to the water treated that keeps on acting on the bacterial life even after the water has passed through the sterilizer. This has been called "residual action," and tests and studies have shown that a reduction of 85 per cent may be accomplished in bacteria added to water which has previously been treated by the ultra violet ray process. This opens up an extensive field for study and is very important when swimming pools are considered.

The Ultra Violet Ray Sterilizer is in use on many pools in prominent athletic clubs, schools, colleges and universities the country over and many municipal pools and public pools such as the mammoth pool at Madison Square Garden, New York City, with excellent results. It has been the uniform experience that the water in the pool proper can be maintained within the bacteriological standard of purity for drinking water even while the pool is in constant use by bathers and though the water has been used for extremely long periods without change. Many pools have used the water for over a year without change and practically all for periods of six months at least. This results in great savings in operating expense as well as insuring a pool of satisfactory purity.

The Ultra Violet Ray Sterilizer is not only used with great success on swimming pools but also for the sterilization of any water supply such as those in municipalities, industrial plants, office buildings, hospitals, homes, as well as for bottling plants for use on the product water and also on the water used for giving the final rinse to the bottles. Practically all of the passenger boats on the Great Lakes are equipped with the Ultra Violet Ray.



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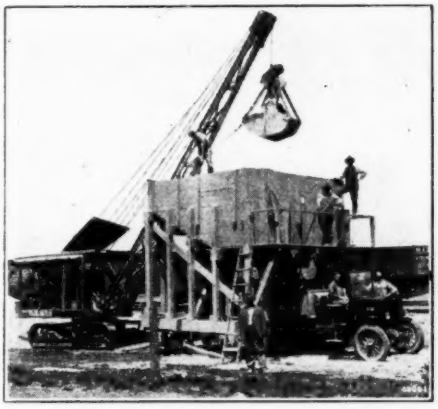
Construction News and Equipment

SUCCESSFUL COORDINATION OF PLANT UNITS ON WISCONSIN ROAD JOB

This story of the relation between materials on hand and successful rapid construction of a highway project is centered about the work of the Wisconsin Construction Company, of Milwaukee, on the Horicon-Beaver Dam Road, on Route 118, in Dodge County, Wisconsin. It is a story of the successful coordination of the integral parts which go to make up a construction plant.

Long before the mixer was on the job, two months nearly, the locomotive crane was unloading all the sand and stone that could be obtained. Ten or twelve cars per day were placed in storage until, when the mixer was ready to start, 10,000 yds. of materials were on hand, or sufficient to complete nearly four miles of 18 ft. roadway. At Rolling Prairie, the shipping point, the contractor found a passing track about 1,000 ft. long. The use of this he obtained for handling his aggregate cars. He also obtained the unused portion of the railroad right of way and leased an additional 50 ft. from the land owner next door.

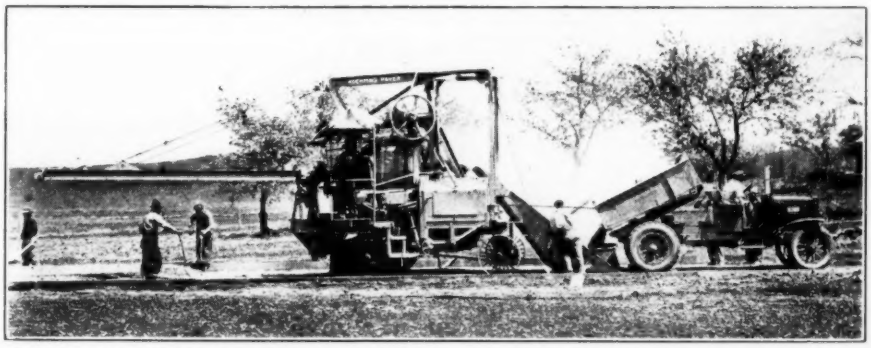
The crane, which has a 40 ft. boom, unloaded the sand into a pile approximately 20 ft. wide at the base. The stone was unloaded in a parallel pile approximately 50 ft. wide at the base. In laying out the plant it was planned to store more than one-half as much sand per foot of pile as of stone, the reason being that the crane must move longitudinally and must at all times be back of the stone pile. In case an insufficient amount of sand is delivered the excess allows leeway before the stone pile is in the way of the crane. In case stone is not delivered



A MATERIAL HANDLING PLANT USED ON THE HORICON-BEAVER DAM, WIS., ROAD CONSTRUCTION JOB.

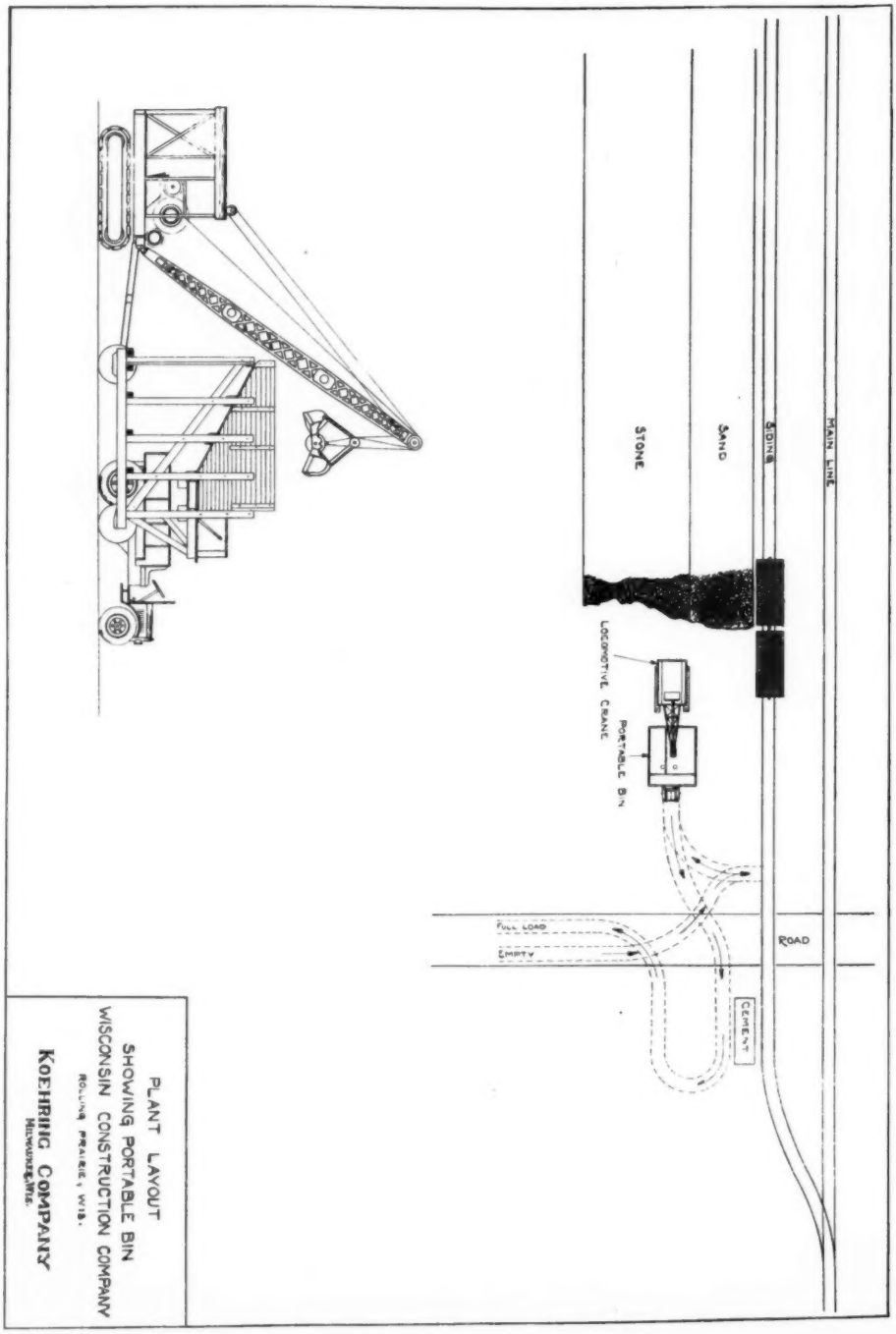
and sand is delivered the crane can operate from the sand pile with ease, handling the sand directly from cars to bin and stone from the storage pile to the bin. The sketch and photographs show the layout.

To make this operation complete a portable bin was necessary. The bin is approximately 14 ft. square and 18 ft. high,



TRUCK DUMPING DIRECT TO KOEHRING MIXER LOADING SKIP ON HORICON-BEAVER DAM, WIS., ROAD JOB.

made of white oak throughout. It is mounted on road wheels, 40 ins. in diameter and with a 12 ft. base. Attached by the rigid 10 ft. pole to the crane mounted on multiplanes, it moves forward as the crane moves, thus making unnecessary the peaking of the boom at any time. The bin is supported at three points, the two rear wheels and on the fifth wheel of the front axle. In this way strains due to



KOEHRING

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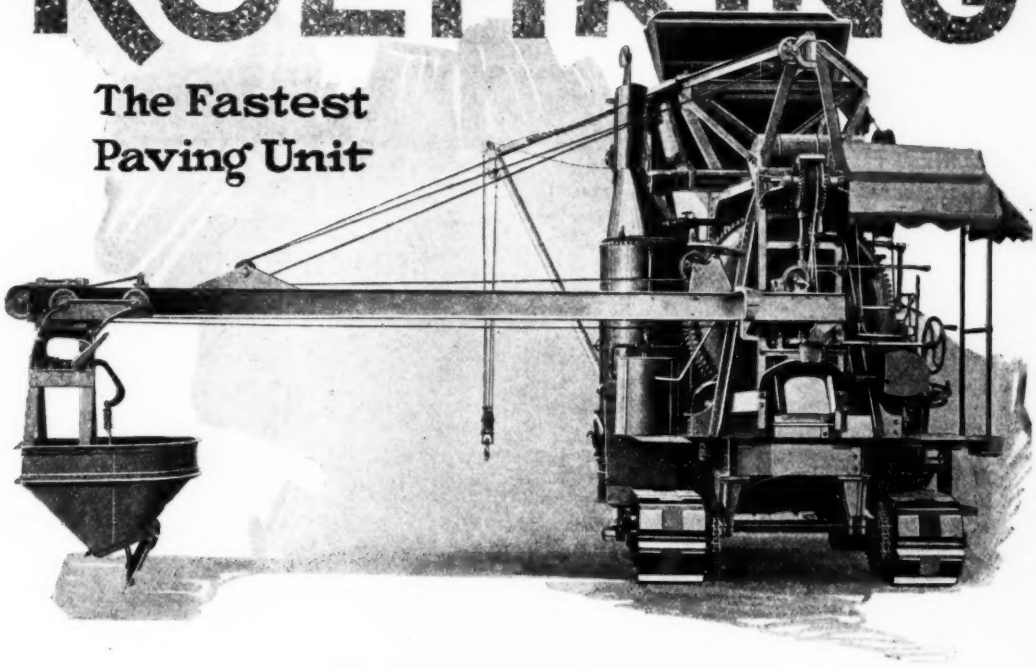


Heavy Duty Construction is Still the Greatest Profit Factor

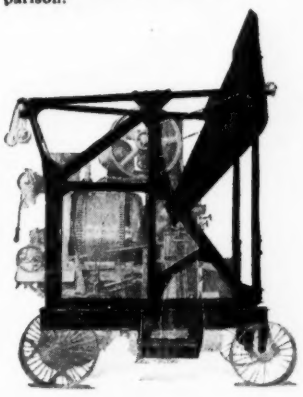
IT'S true absolutely! There's a quick *halt* all along the line when the mixer balks! *It's the mixer that is still the narrow neck of the job.*

Your greatest *profit insurance* is mixer *dependability* —which is just another term for Koehring Heavy Duty Construction.

That's why Koehring would no more build to meet price competition than he would cut down on the safety margin of cables for a passenger elevator.

Koehring *on-the-job dependability,* together with Koehring high speed operation, liberal drum dimensions, automatic actions in charging, discharging and distributing, mean a real profit *insurance* —a liberal extra yardage every day, a *big extra yardage every season.* Write for catalog.

The high angle charging position of the Koehring charging skip shoots materials into the drum in a swift, clean slide—and the Koehring frame is built to stand high speed operation of a loaded skip—without chance of frame twists throwing moving parts out of alignment. Next time you see a Koehring, see how that frame is put together—and remember it as a point for comparison.



KOEHRING COMPANY, MILWAUKEE WISCONSIN

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uneven bearing are reduced to a minimum. Forty yds. of aggregate, 15 yds. of sand and 25 yds. of stone are carried at all times in the bin. Two measuring hoppers are mounted below the bin floor, so designed that they can be adjusted to fit any proportion. Levers controlled from the platform operate the upper and lower cut-off gates.

The two compartment trucks back under the bin receive 27½ cu. ft. of aggregate in each compartment and drive to the cement shed where they are loaded with 2½ barrels of cement, the bags being emptied directly on top of the aggregate. The truck hauls the material to the site of the work. Here it turns and backs into the skip of the 21E Koehring paver, discharges the load and moves forward about 2 ft. The skip is then raised, the material charged into the drum of the mixer, the skip lowered and the truck again backs into the skip, discharges the second batch and leaves for another load.

When mixed, the concrete is discharged into the boom bucket. This bucket is of the spreading type. In other words, the door opens crosswise instead of longitudinally. It consists of a single leaf, hinged at the back of the bucket which is released by the operator from his platform. The concrete is spread in an even layer as the bucket is drawn back. In case it is desired to push the concrete into a corner of the form, this can readily be done by reversing the motion of the bucket. The door is then used as a plow to spread the concrete into place.

The organization of the crew is as follows:

1 Crane operator.
10 Cleaning up cars and assisting around plant.
7 Handling cement at cars and warehouse.
1 Bin operator.
1 Loading foreman.
11 Trucks with drivers.
2 Dumping trucks.
1 Mixer operator.
6 Finishers.
2 Form setters.
4 Extra men sprinkling and covering pavement.
7 or 8 men on grade ahead of mixer.

The finishing is done by hand by the use of a strike-off board followed by the roller and belt.

The day following the placing of the concrete it is protected by covering with earth. The success of this operation is shown by the fact that the first mile of highway was built, even with an average round trip haul of between 7 and 8 miles, in 9 working days. This does not mean 9 calendar days, for due to rainy weather it was possible to work only 9 days out of 20.

This quantity was placed with a green crew and green truck drivers.

The work is in charge of Mr. P. C. Kwerk, sole owner of the Wisconsin Construction Company, who is being assisted by A. G. Brown and Geo. H. Kies.

THE VALUE OF STANDARDIZED CONSTRUCTION EQUIPMENT

By H. A. Hooker, Austin Machinery Corporation, Railway Exchange Bldg., Chicago, Ill.

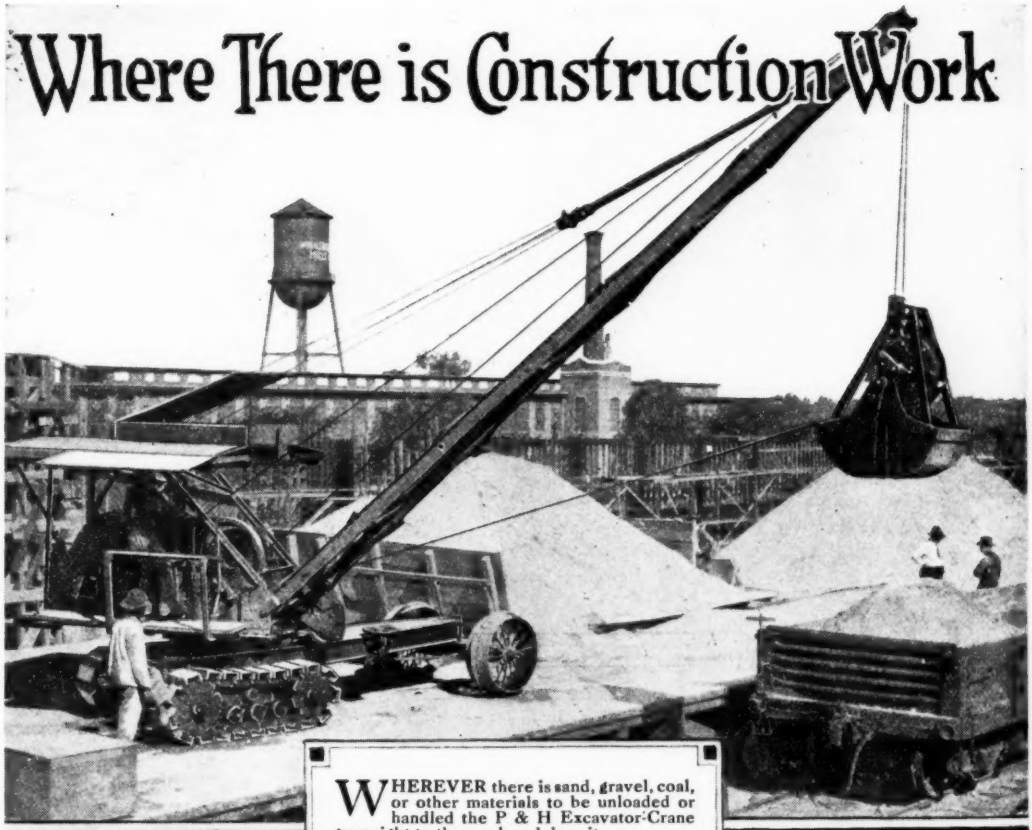
For years the value of standardizing on machinery has been recognized by manufacturers of many classes. Contractors on the other hand, have been very slow to see the advantage.

A contractor depends much upon his superintendent when the purchase of a machine is taken up. Often the contractor overrules the superintendent whose inclination is naturally toward standardization when possible. Contractors seldom admit losses and therefore a contractor often thinks his competitors are more successful than himself, and must have better machinery, especially if he remembers how the purchase was influenced by price.

Today, however, some of the large contractors are becoming alive to the value of standardization of equipment. They have their engineering department keep cost records and make comparisons of operating costs versus depreciation and upkeep. These records are not simple to keep as to be accurate and useful they must take into consideration many conditions of material, labor and climatic interruptions. The same crew and equipment may lay ten or a thousand lineal feet of concrete pavement, depending upon one or all of a half dozen contingencies.

The money that a contractor makes is the difference between his costs and his contract price. His contract price should be based upon the average cost plus depreciation of equipment, and profit, and, naturally, the more accurate his costs the more certain his profits. At this very point, standardization means much to him in real money, as it gives him a more accurate average cost, and this in turn makes his chances of obtaining a profitable contract that much better. His foremen are interchangeable, as well as

Where There is Construction Work



WHEREVER there is sand, gravel, coal, or other materials to be unloaded or handled the P & H Excavator-Crane goes right to the work and does it.

Structural steel or timber may be unloaded and carried to the job, scrap iron or other steel or iron may be cleared away with a lifting magnet.

Digging is quickly done with excavator bucket, and a scraper bucket may be attached to the crane for grading or filling-in.

If in the round of work some pile-driving must be done—this, too, can be accomplished.

In fact, "Old Bess," as this general utility crane has been called, pokes her nose all over looking for work to do. And she'll do it for you, if you'll let her.

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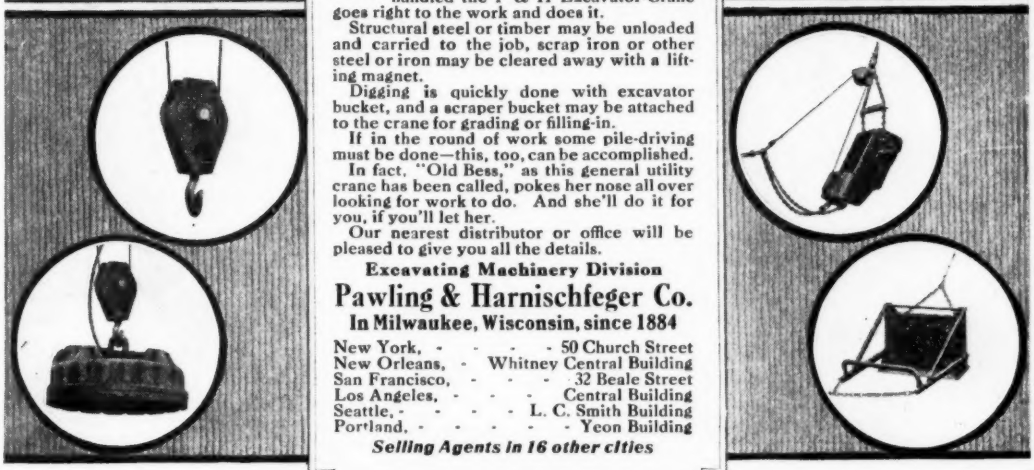


P&H EXCAVATOR-CRANE

the parts of his machines; his operators, assistants from water-boy up become schooled so that the loss of an operator is not a calamity, and the men do not feel so independent and therefore more liable to make an extra effort to please. Every contractor tries to keep some repair parts on hand and standardization simplifies the effort and enlarges the variety at a less outlay. It also simplifies the ordering of same.

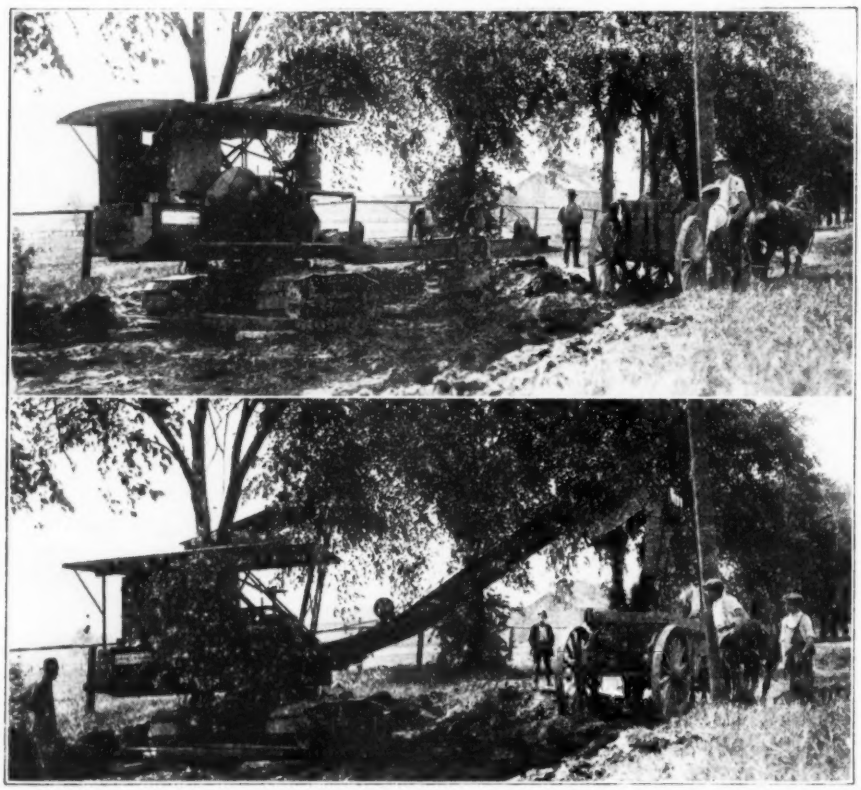
The greatest effort at standardization that has come to my attention was that of Bates & Rogers of Chicago. For one and one-half years they tested and kept cost records on six different makes of paving machines after which they standardized on one make, contracting for eight pavers and selling the others.

Standardization of equipment allows little chance for the passing of responsibility, as one superintendent has an equal chance with another and it creates a contest of superintendents in appearance of machines, upkeep expense and work produced. This spells profit for the contractor.

When possible to purchase full equipment from one company, and time payment is desired, financing is much simplified.

NEW P & H SKIMMER SCOOP MAKES BIG SAVING ON ROAD GRADING JOB

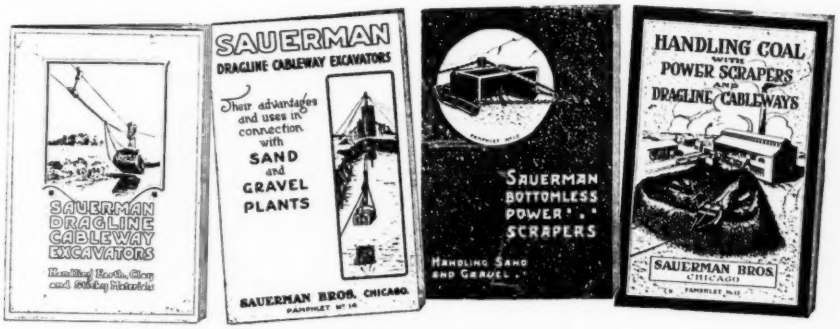
A new Skimmer Scoop has been put on the market by the Pawling & Harnischfeger Co. of Milwaukee, to be used with either the No. 205 or No. 206 P. & H. Excavator-Crane. This may be attached in place of the standard boom in a manner similar to the shovel attachment which was brought out early this spring. The development of this skimmer scoop broadens the field of application of P. & H. excavator-cranes, allowing the contractor



P. & H. CORDUROY TRACTION EXCAVATOR-CRANE EQUIPPED WITH NEW SKIMMER SCOOP.

All Operations Controlled by One Man on Machine. After Scraper Bucket Travels from Near End of Boom to Opposite End, Boom Is Raised, Swung Over Wagon and Load Released. Then It Is Returned to Starting Position, Boom Lowered to Position Desired and Another Load Scraped Up.

Which of these Booklets do *You* Want?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HANDLING COAL WITH POWER SCRAPERS AND DRAGLINE CABLEWAYS
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Pamphlet No, 15 gives details and illustrations of the various types of dragline cableway excavator installations that interest engineers, dirt-moving contractors and clay plant owners.

Pamphlet No. 14 is a handy compilation of data on the dragline cableway excavator method of excavating and conveying sand and gravel, illustrated with many views of typical installations,

Pamphlet No. 12 describes the latest developments in the use of mechanical drag scrapers for handling gravel from hillside, and explains the adaptability of power scrapers for small pits.

Pamphlet No. 11 illustrates practical solutions of various coal storage problems by use of scrapers and dragline cableways, some of this data being now published for the first time.

We invite your request for any or all of the above booklets.

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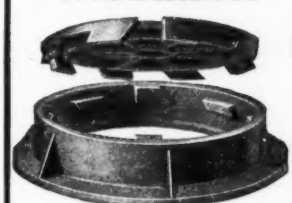

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to keep down his investment in machinery. The upper illustration shows the skimmer scoop on the full-corduroy No. 206 machine working on a road grading job, Hawley Road, Milwaukee County, Wisconsin. Here the bucket is shown at the end of the travel along the boom, while lower view shows the boom elevated and the load being dumped into a wagon.

That this type of road making machine is of real value is shown by the accompanying record. The contractor (William Datka of Milwaukee) on the Hawley Road grading job kept an accurate record, and a saving of $83.44 per day was made, and the work done in shorter time. The data are as follows:

Number of days on job	8
Total cu. yds. excavated	2,578 cu. yds.
Total hrs. worked	79
Excavated per hr.	32.6 cu. yds.
Number of days saved in using machine in place of wheelers and ploughs	2 days

The operating costs were:

Total cost per day operating with skimmer scoop, including interest and depreciation (assuming 5 yr. life of machine)	$ 91.25
Number of days operating	8
Total cost	730.00
Total cost per day with wheelers, scoops and ploughs	130.00
No. of days (estimated)	10¾
Total cost	1,397.50
Total cost with skimmer scoop	730.00
Difference	667.50

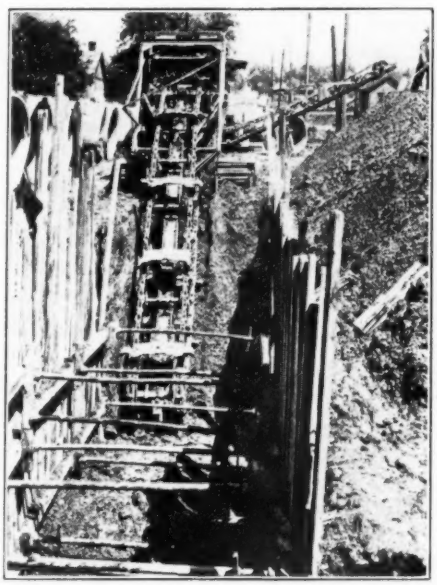
CONTRACTORS URGED TO EMPLOY LOCAL LABOR

A statement, urging contractors to employ local labor, was recently issued by Lewis S. Sadler, State Highway Commissioner of Pennsylvania, as follows: "A survey of the state discloses the fact that in almost every community there are large numbers of unemployed men and that this number is increasing weekly. The Highway Department is anxious to relieve this situation insofar as the contracts under its direction will afford employment. In view of the fact that practically all communities are affected alike and that there is available a local supply of labor for all our existing contracts, our contractors are being urged to seek the services of men living in the community in which they are operating rather than to import labor from a distance; and especially are they being urged not to interfere with such labor as is, or will be, employed on the farms of the commonwealth."

TRENCHING MACHINE PERFORMANCE DATA

At Muncie, Indiana, contractors, Harris-Andrews-Henderson Co., of Youngstown, Ohio, have been excavating a ditch 20 ft. deep and 108 ins. wide at the rate of 266 lin. ft. per day of 10 hours. They use a 54-in. Austin Machinery Corporation trenching machine, with which they work two cuts. Due to the readiness with which the boom can be raised, the time consumed to raise the boom, move the machine forward, and then backward ready to take the other half of the cut, is approximately only two minutes.

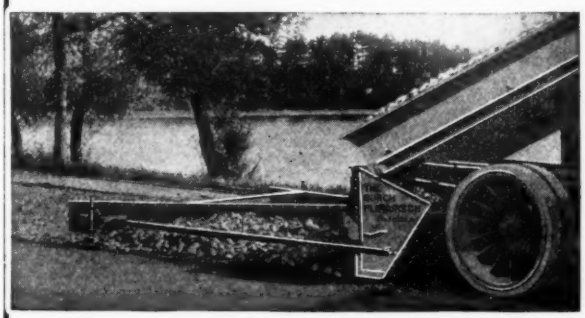
The distance between the center of the multipedals and the breast of the bank is 8 ft. 6 ins., so that the length of each cut must necessarily be just a little less,



EXCAVATING 47,880 FT. OF DIRT PER DAY WITH A 54 IN. AUSTIN TRENCHING MACHINE DIGGING A DITCH 108 INS. WIDE.

or 8 ft. 3 ins. The speed of the machine is about 1 lin. ft. per minute, making the operation of digging 8 lin. ft. the full 104-in. width in 18 minutes, or at the rate of 80 cu. ft. of dirt a minute.

The Austin trenching machine is equipped with a 100 H.P. gasoline engine and will dig from 27 to 54 ins. wide, and any depth up to a little better than 20 ft. Cost of operation never exceeds $25 per day of 10 hours—a very low cost for excavating 47,880 cu. ft. of dirt a day.



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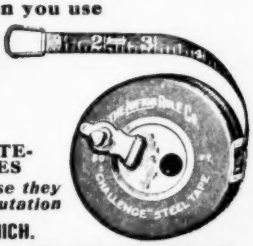

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Contracts Awarded

ROADS AND STREETS.

Ala., Livingston—W. K. Saulsbury & Co., Birmingham, awarded contract to constr. 9 mi. bitum. macad. road, penetration method, at $177,000; Finnell Co. Tuscaloosa, awarded contract to construct 9 miles clay and gravel rd. at $123,000.

Ala., Montgomery—Stanley & Singer Constr. Co. La Fayette, awarded contr. for grading, draining and surfacing 17.6 miles of road from Talladega to Calhoun Co. line, Sec. A, Talladega Co., chert or gravel; $143,715; 5.12 mi. rd. from Talladega to Calhoun Co. line, Sec. B, chert or grav., at $35,940; 2.296 mi. Jackson Hwy. Wash. Co. gravel, $47,661; 13.995 mi. rd. from Calvert to Axis, gravel, $112,316; to Commrs. Pike Co. Troy, grading draining and surfacing 10.226 mi. of road from Banks to Brundidge, Pike Co. at $40,452.

Ariz., Phoenix—Warren Bros. awarded contr. to pave Culver St.—Central Ave. to 12th St.; at abt. $45,000; White & Miller, contr. at abt. $40,000 to pave E. Portland St. from Central to 7th at abt. $40,000; R. L. Ballinger, contr. to pave S. 3rd St.—Jefferson to Grant—at abt. $45,000.

Cal., Los Angeles—Sierra Conc. Co. 1743-B Garfield Pl. awarded contract by county supvrs. to grade and pave Anaheim-Spadra (Brea Canyon) road with 6-in. conc. at $84,852.

Cal., Los Angeles—Tryon & Brain, 210 Tajo Bldg. awarded contr. for grading and oiling 8th St.—Gaffey to Moyler Sts., San Pedro at $9,556; Baker & Chalmers, 312 American Bank Bldg. awarded contr. for grading and oiling Melrose Ave.—Virgil to Vermont Sts.—at $14,484; Los Angeles Paving Co., 2900 Santa Fe Ave. award. contr. for paving Hawthorne Ave.—Inglewood to Redondo Rd.—at $181,999.

Cal., Sacramento—Chadwick & Sykes, San Francisco, awarded contr. for grading 10.6 miles state hwy. in Trinity Co. at $172,076.

Cal., Sacramento—Following contracts for state hwy. work awarded: Bates & Rogers Constr. Co., San Francisco, contr. for paving with concrete 19.4 miles in Merced County—Los Banos to East boundary at $275,722; W. A. Kettlewell & Sons, Kingsburg, awarded contr. for impvt. of 5.7 miles in Butte Co.—4.2 miles to be graded and 1.5 miles to be paved with concrete, at $53,938.

Cal., Ventura—Southwest Paving Co. Washington Bldg., Los Angeles, has signed contr. amounting to abt. $172,000 to pave certain city streets. Certain legal questions, regarding grade of streets, must be determined before constr. can start.

Colo., Colo. Springs—Ed Honnen, City, awarded contract for resurfacing Canon City road so. of here (3.29 miles) at $28,122. Other contracts let were as follows: bet. Buena Vista and Divide, 5.09 miles grading & drainage; $74,816, to J. N. Gordon, Denver; 2.07 mi. conc. paving bet. Greeley and Lasalle, at $66,337 to H. R. Phillips, Denver; 1.05 mi. bet. Gray and Silverton, grading & draing. at $28,628; L. M. Spencer, Denver; bet. Limon & Genoa, 9.87 mi. sand & clay grading, to Ed. Lindsey, Denver, at $43,796; no. from Cheyenne Wells, 8.78 mi. gravel grading, $21,675, to Morrison & Crossen, Sterling; bet. Colo. Sprgs. & Florence, 3.29 mi. sand & grav., surfacing, $28,122; Ed Honnen, Colo. Sprgs.; bet. Denver & Ft. Lupton, 4.77 mi. conc. paving $135,132 to Alb. Dobie, Sterling; Grand Jct. to Fruita, 8 mi. conc. paving at $29,788 to Rogers Bros. Florence; 3.38 mi. bet. Limon and Pattison, sand & clay surfacing, $24,767, to Pickering Bros. Salt L. City; 3.2 mi. gravel surfacing bet. Sapinero and Gunnison, at $33,628; Girardst & Hotchkiss, Delta; bet. San Luisa and Ft. Garland 2.13 mi. grading and draing. at $10,571; Carl Carlson, San Acacio, Colo. and bet. Rifle and Meeker, 3.2 miles shale surfacing, at $18,416 to Henry Shore,

Ill., Danville—J. W. Bushell, Peoria, awarded contracts for asph. pavement on four streets here at $216,983. This contractor also has contract for repaving Jefferson Ave.

La., Baton Rouge—Contracts for graveling roads in 7th road dist., awarded to S. A. Gano; Lawrence, Nixon & Phillips contr. for Highland Road cross roads and section of River Rd., (11 miles in all). Greater Agricult. College will construct abt. 1 mi. rd. along property of college. Approx. $130,000 provided for bldg. these rds.

Md., Elkton—Fish Bros., awarded contract for constructing 1.21 mi. conc. hwy. from Cowenton to Elk Mills, at $43,562; Cecil Co. to Claiborne, Johnston & Co., Garrett Bldg., Baltimore, at $145,169, to construct 4.06 mi. conc. hwy. from Perryville to Tome Sch. entrance.

Mich., Crystal Falls—House & Person Constr. Co., Iron Mountain, awarded contract for grading and draining State Trunk Line Rd. 69.3, at $163,399.

Mich., Marquette—Marquette County Rd. Com-

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mrs., Ishpeming, awarded contr. by St. Hwy. Dept., for grading, draining and surfacing 10.341 miles State Trunk Line Rd., 35-8, Sects. A and B, at $221,250.

Mich., Ontonagon—McDonnell and McFarlane, St. Louis Hotel, Duluth, awarded contract for grading, draining and surfacing 2.513 miles State Trunk Line Rd. 26-11, at $100,320.

Minn., Duluth—Following contracts let for road work: St. Job 2101, St. Hwy. 3, to D. H. Clough Co., ft. 23rd Ave. E., Duluth, at $161,797; grading Congdon Blvd. along shore Lake Superior, from city limits at Lester Pk. to Lake county line, 8 miles; St. Job 2115, to Jackson Bros., 410 Columbia Bldg. Duluth, at $447,466; pave 12 mi. extending s. from Canadian Northern R. R., on Miller Hwy, 48,000 sq. yds. paving, St. Job 2003, to A. Guthrie & Co., 366 Jackson St. St. Paul, to E. F. Remer, Hibbing, & Minkler Krowpitch, Buhl, at $278,818; grading highway bet. Virginia and Chisholm, 15 miles, St. Job 2101, Hwy. 35, to A. Guthrie, 366 Jackson St., St. Paul, at $346,599; 20 mi. grading bet. Soudan and Ely, St. Job. 2102, to Coons-Winston Co. Hibbing, at $272,958; 15 mi. grading bet. Virginia and Aurora, Pav. Job, to Jacobson Bros. Columbia Bldg. Duluth, at $505,394.

Neb., Norfolk—Abel Constr. Co. Lincoln, awarded paving contract here at $200,000.

N. J., Belvidere—Freeland Constr. Co., Allentown, Pa., awarded contr. for paving 5 miles Sec. 3, Morris Turnpike, from Phillipsburg to New Village, at $241,463.

N. J., Salem—E. A. Corson, Ocean City, awarded contr. for paving 4,200 ft. rd. from Pennsville toward Salem and 7,200 ft. rd. from Churchtown to Pennsville (both conc.) at $32,000 and $54,000, respect.

N. Y., Niagara Falls—J. F. McKinney Corp. awarded contract for repairing 19th Street, with Bessemer vertical fibre block, at $115,000.

N. C., Greeneville—Cheatwood-Driscoll & Co., Richmond, Va., awarded contract for constr. of hard surface rd. from Greeneville to Ayden, at $250,000.

N. D., Minot—Stevens Bros., 15 Piedmont Bldg., St. Paul, Minn., award. contr. for 18 miles state hwy. west of here, at $81,189.

N. D., Watrous—Jacob Mehrer, Watrous, awarded contract for grading 10 miles of road in Merrill Twp. at $122 per mile, 34 ft. wide, ditches 6 ft. wide, 20 ins. deep, crowned road.

Ohio, Columbus—Cleveland Trinidad Paving Co., The Arcade, Cleveland, awarded contract for grading and paving Broad St. approach to bridge.; brick, at $35,371; A. W. Burns & Co., 502 Grand Theatre Bldg., award. contract for grading, bldg. bridges and culverts and paving 3.179 mi. Lane Ave., bitum. macadam, at $85,626.

Okla., McAlester—Jno. Rooks, awarded contract for paving at $15,726; Pharaoh Bros., Paul's Valley,, awarded contract for constr. of 18-mile hwy. from Tishomingo thru Nida and Milburn to Bryan Co. Line, at $203,000. Crush rock and gravel with 18-ft. rdwy.

Pa., Oakmont—Haverford Twp. let contracts for bldg. various roads Sects. 1 and 3, to O'Neill Co. 127 E. Mermaid Lane, Phila., at $71,490 and $52,490, respectively; Sec. 4, to Am. Paving & Material Co., 207 S. 9th St., Phila., at $58,654; Sec. 5, to F. L. Ramsdale & Co., Phila., at $62,800; Sec. 6, to L. Mariani & Co., Phila., at $63,710; Sec. 7, to A. J. & D. M. Fraser, Phila., $48,145; Sec. 2, to Larson Underpinning & Constr. Co., Phila., at $49,903.

Pa., Philadelphia—More than $1,240,000 paving contracts awarded in all sections of city by Dept. Pub. Wks. Most important work is repaving main traffic arteries with redressed granite block on a heavy concrete base. One of the largest contracts let to Acchoine & Canuso, for reconstr. of Delaware Ave.—Vine St. to Fairmount Ave. at $131,342; Union Paving Co., Germantown Ave.—Front St. to Montgomery Ave., $83,111; W. H. Yetman, Jr., Grays Ferry Ave., at $47,395; Fish-Rutherford, Inc., Ridge Co., at $74,361; M. J. McCrudden, Ridge Ave., $100,665; Eastern Paving Co., Main St. and Ridge Ave., at $73,409; Union Paving Co., Woodland Ave., $57,234; Acchuone & Canuso, Woodland Ave. at $69 128; Robt. Lombardi, 5th & 6th Sts., at $80,114; McLaughlin and Flood, Fifth St., $63,912; McLaughlin & Flood, 6th St., at $67,435; Brow-King Constr. Co., 5th & 6th Sts., at $86,272; Ryan Constr. Co., Sixth St., at $47,847, and 6th St., at $50,042; Eastern Paving & Constr. Co., repaving 22nd St., at $53,615. Asph. contrs. for new paving include Fairhill St. to Eastern Paving Co., at $14,453; Horrocks St.—Harrison to Wakeling, at $9,052.

Pa., Pottsville—Contract signed with American Paving Co., Chester, for paving North and So. Centre Sts. and W. Market Sts. with Trinidad on trap rock base, with granolithic curbing and vitr. brk. where grades make changes necessary. N. Centre proj. will cost $29,000, So. Centre St., $58,401, and W. Market St. proj., $197,893.

S. C., Columbia—Chatham Paving Co., Savannah, Ga., awarded contract for paving 18.5 miles Newberry Road; cement concrete surface, at $489,253.

Tenn., Huntington—W. T. Hadlow, 16 Baldwin Bldg., Jacksonville, Fla., awarded contract for grading and surfacing 10.01 mi. of road in Marion Co., at $178,589.

Tenn., Knoxville—Murray Constr. Co., City, awarded contract to pave E. 5th Ave. and E. Clinch Aves. with Trinidad asph. conc. at $255,417.

Tenn., Rutledge—A. B. Crump Constr. Co. awarded contract for constr. of 20 miles bitum. macadam hwy., at $276,000.

Tex., Sierra Blanca—H. E. Williams, El Paso, awarded contract for constructing Sects. A, B, C and D on Hwy. No. 1, 24.51 miles gravel road, at $128,314.

Va., Charlottesville—H. H. George, Richmond, Va., awarded contr. to construct conc. rd. from here to Heath, at $300,000; C. S. Luck, Richmond, Va., contr. to pave 3½ miles of road, at $100,000.

W. Va., Beckley—Mountain State Constr. Co., Huntington, awarded contract for paving streets here at $100,000.

Wis., Fond du Lac—Stein Constr. Co., 204 Grand Ave., Milwaukee, award. contract for paving 8th, 11th and 15th Sts., Hickory, W. Division & Dix Sts., at $106,933.

Wis., Marshfield—Drath Constr. Co., Berlin, Wis., awarded contract for paving stretch of hwy. from Seneca Cors. to Wisc. Rapids—approx. 4 miles, at $110,000. Specfs. call for 16-ft. roadway of concrete.

Wis., Monroe—Perry Fess, Madison, awarded contract for Belleville-New Glarns Rd. at $100,586.

SEWERAGE AND SEWAGE TREATMENT.

Cal., Los Angeles—Andrew Jayich, 203 Leroy St., awarded contr. for constructing cem. pipe sewer in Clanton St., San Pedro, at $1,674; Adam Dalmatin & Mike Guho, 818 E. 40th St., contr. for constructing cem. pipe sewer in Indiana Street sewer dist., at $70,215; B. Z. Wucetich, awarded contr. for constr. of sewer in Grand Ave. (San Pedro) at $145,000.

Ga., Atlanta—Wood-Rucker Constr. Co., 502 Walton Bldg., Atlanta, awarded contract for constr. of sewer extension in towns of Decatur, Kirkwood and East Lake, Ga.; work to consist of 3,800 ft. 12-in. outfall with manholes and appurts.; also contr. for constr. of 2,000 ft. additional sewer lines in town of Kirkwood, Ga.

Ind., E. Chicago—Shea & Co., Hammond, Ind., awarded contr. for constr. of pumping sta., necessary equipment and reconstr. of main sewer, at $123,773.

Ia., Arnold Park—O. W. Gjelleford, Forest City, awarded contract for bldg. sewerage system at $57,133; disposal plant to Nelson-King Co., Spencer, at $18,000.

Ia., Manchester—W. Jewell, Manchester awarded contr. for bldg. 8-12 in. san. sewers in S. Tama and Vine Sts., at $25,394.

Ia., Mason City—J. A. McDonald Constr. Co., Builders' Exch., Minneapolis, awarded contract for conc. reservoir, at $51,920.

Kans., Atchison—O. H. Schmidt, 3402 Renick St., St. Joseph, award. contract for laying 8-12 in. sewer pipe in various streets, at about $25,000.

Ky., Corbin—Howerton, Tinsway Co., Asheville, N. C., awarded contr. to construct main outfall sewer, including 600 lin. ft. 24-in. c. i. pipe and 2 miles 7 to 24 in. vitr. clay sewer pipe, at $46,000.

Mass., Boston—A. Baruffaldi, awarded contract for sewerage works in Glendale Rd. and North Ave., W. Roxbury, at $46,554.

Mich., Detroit—B. Hayes, 6880 Clayton Ave., awarded contract for bldg. sewer in Seven Mile Rd. —Keystone to Fleming Aves.—Sects. 3 and 4, involving 7,570 ft. 11½ ft. pipe, at $500,845.

Minn., Stillwater—McGee, Nolan & Brotherton, Stillwater, Minn., awarded contract for constructing Mulberry St. outlet sewer at $62,699.

Minn., Twin Valley—O'Neill & Preston, 608 Ex-

change Bank Bldg., St. Paul, awarded contract for sewer system at $27,208.

Minn., W. St. Paul—Thornton Bros., St. Paul, awarded contr. by city of West St. Paul, for 27,752 lin. ft. 8-in., 10-in., 12-in. and 15-in. san. sewer, including 83 manholes, large and small, at $50,787.

N. J., E. Orange—Peter D'Amato, 74 Summer Ave., Newark, awarded contr. for construction of Fifth Ward Drain, at $29,147.

N. J., Newark—Abbott & Cestone, Montclair, N. J., awarded contract for constructing Kearny-No. Arlington branch intercepting sewer at $24,000.

N. Y., N. Y. C.—Slattery Engrg. & Contg. Co., 7 East 42nd St., awarded contract for bldg. sewer and appurts. in W. 187th St. and Ft. Washington Ave., at $43,819.

N. Y., Syracuse—Contr. for bldg. outfall sewer in Onondaga Lake, let to C. T. Hookway, Bastable Bldg., at $71,992; outfall sewer from water line of lake, to T. A. Scott, 292 Pequot Ave., New London, at $65,168.

N. D., Mandan—W. E. Kennedy awarded contract for trunk sewer and laterals, at following unit prices: 60-in. Monolithic conc., at $16, 60-in. inter seg. blk., at $22, 8-in. laterals at $1.40 and 10-in. at $1.50; manholes at $70. Total cost of work, $43,114.

Ohio, Akron—City let contr. for constructing 8-36 in. sewer bet. Aqueduct St. and Little Cuyahoga River to J. B. Dorris, Akron, at $40,170; 1,940 ft. 7-ft. 3-in. to 7-ft. 6-in. trunk sewer to extend from Spicer to Crouse Sts. to T. E. McShaffrey Co., Rhodes Ave., at $77,447.

Ohio, Cleveland—Randall & Cooper, Cleveland, award. contr. covering constr. of sewer in Oak Bark Ave., SW at $22,000; Wm. McDowell & Son, 10319 Miles Ave., award. contr. for constr. of sewer in E. 133rd St., at $32,391; Chester Ave. to Manson Co., 1134 E. 71st St., Cleveland, at $13,600; E. 123rd St. to Wm. McDowell & Son Co., 10319 Miles Ave., Cleveland, at $36,000; 5 streets in Leisy allotment to Salem and George Bros., 3178 Scranton Rd., Cleveland, at $36,000; Central Ave., Sec. 3, to Hanson Co., 1134 E. 71st St., Cleveland, at $45,000.

Ohio, Columbus—The H. S. Bosier Constr. Co. awarded contr. for constr. of sewer in Rose Ave.—Leonard Ave. to alley no. of Snyder St., at about $214,000.

Ore., Portland—J. F. Shea, Henry Bldg., Portland, awarded contr. for constr. of sewer at $338,634.

S. C., Pickens—J. B. McCrary Co., Atlanta, Ga., awarded contract to install sewer and water systems. Approx. cost, $60,000.

S. D., McLaughlin—Mobridge Plumbing & Heating Co. awarded contract for installing trunk line sewerage system and sewage disp. plant at $58,000.

Tex., Ft. Worth—Westinghouse-Church-Herr Co. awarded contract for constr. of $750,000 sewage disp. plant.

Utah, Ogden—Taylor Childs Co., Ogden, awarded contract for furnishing labor and materials for bldg. sewers in Dist. 144, involving 38. 116-ft. 8-12 in. vitr. pipe and 36,940 cu. yds. earth trenching, at $113,229.

Wis., Cumberland—Bebberg & Rorce, No. Branch, awarded contract for constr. of sanitary sewer system at abt. $70,000; 21,034 ft. 15-in. water pipe, 51 manholes.

Wis., La Crosse—Mankato Constr. Co., Mankato, awarded contract for sewer extension on 17th St. and laterals at $45,381.

WATER SUPPLY AND PURIFICATION.

Ariz., Phoenix—U. S. Cast Iron Pipe & Foundry Co. awarded contr. at about $209,000 for furnishing c. i. pipe for city water distributing system.

Ark., Judsonia—J. Livingston & Co., Grand Cent. Term., New York City, awarded contract by Ark. Hydro-Elec. Co., Little Rock, to build hydro-elec. plant on Red River; gravity type dam, 450 ft., spillway, 80 ft. high with 22,000 h. p. initial installation; cost of dam and power house, $1,460,000; dist. of transmission, 55 miles, 110,000 voltage to Little Rock, total trans. lines of 94 miles, including several short low voltage lines; will probably connect Little Rock, Searcy, Judsonia, Kensett, Augusta and other cities; will develop later, as needed, 14,000 h. p.; contemplates 2 other dams that will give total of 75,000 h. p.; J. E. Sirrine, Cons. Engr., Greenville, S. C.

Cal., Sacramento—Coast Constr. Co., American River, Sacramento, award. contract for purch. and installation of elec. equipt. on filtr. plant at about $46,694.

Cal., San Diego—DeWaard & Cobham, 207 Granger Bldg., San Diego, awarded contract to construct water and sewer system at naval training station at San Diego, at $103,345.

Cal., Santa Monica—Grinnell Co. awarded contract to furnish about 35,000 ft. Cl. B water pipe, 4 to 12 in. at $65,665; also contr. to furnish 75 fire hydrants at $6,696.

Que., Bagotville—Gagnon & Fortier, Jonquieres, Que., awarded contract for constr. of water works; contract at $70,000 for cast iron pipe and lead let to Terreau & Racine, St. Paul Street, Que.

Que., Cap de la Madeleine—H. Mueller Mfg. Co. River Rd., Sarnia, **Ont., awarded** contr. for inlets required for exten. to water wks. sys. at $150,000.

B. C., Courtenay—Contract for steel valves for water wks. awarded to Crane Co., Ltd., 450 Beatty St., Vancouver, at $73,700; Taylor Forbes & Co., 1070 Homer St., Vancouver, awarded contract for small pipe and hydrants.

Fla., St. Petersburg—American Cast Iron Pipe Co., Birmingham, Ala., awarded contract for 27,800 ft. 4-6-12-16 in. water pipe for extensions and 575 ft. 8 and 10 in. water pipe, also for gas extensions, at $41,074.

Ind., Hammond—Shea & Co., Hammond, Ind., awarded contr. for Magoun Ave. pumping station at E. Chicago, at $123,773.

Ia., Arnolds Pk.—Contracts let to following for complete municipal waster system plant; pipe and tile line to Peter Kruse, Spencer, Ia., pumping tank and plant to Waite Engrg. & Constr. Co., Minneapolis, at $26,920.

Ia., Mason City—J. A. McDonald Constr. Co., Builders' Exch. Bldg., Minneapolis, awarded contract for construction of concrete reservoir at $51,920.

Mass., Cambridge—Coleman Bros., Inc., Charlestown, awarded contract for constr. of rein. conc. filtr. works at Fresh Pond, at $791,300.

Mich., Detroit—Midwest Eng. Co., 19th & Martindale Aves., Indianapolis, Ind., awarded contract for furnishing and installing 3 motor driven centrif. pumping units in new high pressure pumping station on Randolph St., at abt. $30,500.

Mo., Brookfield—Cook-O'Brien Constr. Co. awarded contract for constructing reservoir at $116,797.

N. D., Minot—Geo. K. Kemper, Minot, awarded contract for bldg. dam across Mouse river here, at $59,000. Will raise water within city limits about 7 ft.

Ohio, Cleveland—Salem & George Bros., 237 Bradley Court, awarded contract for laying 5,890 ft. 12-36 in. vitr. sewer in Mt. Overlook Ave., E. 124th, 126th and 127th Sts., at $32,227.

Ohio, Cleveland—The Hunken-Conkey Constr. Co., 210 Century Bldg., Cleveland, awarded general contr. for constructing Baldwin reservoir (125,000,000-gal. conc. reservoir) at $2,052,241; Madison Foundry Co., 935 Addison Rd. NE., Cleveland, awarded contr. for furnishing and delivering cast iron adjustable valve boxes for Div. of Water, at $4,857.

Ohio, Columbus—Pitt Constr. Co., Pittsburg, awarded contr. for enlarging purification plant to almost twice its present size at $362,947.

Ohio, Willoughby—Gangl Constr. Co., 737 Natl. Bldg., Akron, awarded contract for bldg. 106x175-ft. conc. equalizing basin, 2,000,000-gal. capy. and 6,800 ft. 12-in. c. i. pipe, at $96,747.

Ore., Baker—Gilmore & Richey awarded contr. for Goodrich reservoir for municipal water supply, at $32,846.

Pa., Phila.—City let contract for furnishing & installing traveling grate stokers for Queen Lane and Shawmont pumping Broad St., N. Y. City, $41,531; furnish'g. & lay'g. 60-in. steel main at

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—Brick Rattlers
—Catch Basin Covers
—Cement Testing Machinery
—Clam Shell Buckets
—Contraction Joint
—Cranes, Locomotive
—Crushers, Stone
—Drag Scrapers
—Dragline Cableway Excavator
—Dump Cars
—Dump Wagons
—Excavator, Crane
—Elevating Graders
—Gasoline Locomotives
—Gravel Screener
—Heaters, Asphalt
—Heaters, Tar
—Hoisting Engines
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—Scarifiers
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Torresdale pumping station to Beam-Craven Co., 605 Market St., at $152,126; furnishing 6, 8, 10 and 12 inch stop valves, to Kennedy Valve Co., E. Water St., Elmira, N. Y., $13,839; furnishing and delivering flanged specials for Queen Lane pumping station, to U. S. Pipe & Fdry. Co., 1420 Chestnut St., at $6,000; furnishing and installing 1 fuel economizer and motor driven fans for Torresdale pumping station, 1 fuel economizer for Shawmont, also 2 for Lardnerss pumping sta., to B. F. Sturtevant Co., 135 N. Third St., $32,000 and $20,000 respect.; furnish'g. & erect'g. motor driven pumps at Roxborough Booster sta. to Dravo-Doyle Co., Commercial Trust Bldg., $19,000; furnishing and laying 6-in. main from Queen Lane Sta. to reservoir, to J. J. McHugh, Phila., at $300,000.

S. D., Redfield—H. E. Stolte, Redfield, awarded contract for rein. conc. reservoir and conc. pump bldg., at $34,985.

Tenn., Nashville—W. S. Rae, Pittsbugh, awarded contract for repairs to floor and walls of city reservoir, at $182,179.

Va., Norfolk—Dermot & Magruder, Lynchburg, awarded contract for laying 39,000 ft. redwood pipe on portions Lake Prince pipe line to city, at $29,331.

Wis., Monroe—C. T. Thorn, Oshkosh, awarded contract for laying c. i. water mains in various streets, at $34,309.

Wis., Sauk City—R. W. Ohts, Ladysmith, awarded contract for constr. of water works system at $3 per sq. yd. Work includes 35,000 sq. yds. rein. conc.

Prospective Work

ROADS AND STREETS.

Ala., Florence—State Hwy. Comn. Montgomery, has authorized bldg. pike road bet. so. end of Florence brdg. and top of mountain south of Tuscumbia; $200,000.

Ala., Mobile—Mobile County plans to resurface with oyster shell and repair draing. structs. on 5 miles Coden-Bayou la Batre Rd.; grade, drain and surf. 5 miles Belchamps-Coden Rd., shot ore or oyster shell; 5 mi. Lott Rd. sand clay or clay gravel; 4 mi. rd. from Irvington to Boulevard and Bayou la Batre Rd., shot ore; 6 mi. Mt. Vernon-Citronelle Rd., 14 mi. Celeste Rd., 10 miles Union Church-Churchill Rd., 5 miles Shelton Rd., 14 miles Calvert-Citronelle Rd., all sand clay and shot ore; 1½ mi. Government Street Rd. and 3 mi. Tanner Rd., both conc.; 3 mile Frohsin, 3 mi. Venetia, 4 mi. Fulton, 4 mi. Conception St., 1 mi. Telegraph and 4 mi. Theodore-Delchamps Rds., 2½ mi. rd. from Tanner Rd. at Wheelerville to Orchard, 10 mi. Howells-Ferry Rd. thru Orchard to Schellinger Rd. etc., all clay gravel. S. M. Adams, Mobile, Engr.

Ark., Batesville—$500,000 bonds will be sold to constr. hwy. from Batesville to Mammoth Spring. Plans under way for road from here to Newport.

Ark., No. Little Rock—City Engr. Lawrence states that 26 blks. conc. will be added to city hwys. 13th Street will be paved from Main west to Sycamore St., Sycamore—north from 13th to 16th; 16th west to city limits.

Ariz., Phoenix—City Comn. has authorized over $150,000 worth of street paving here. City Engr. Hitchcock also authorized to prepare plans for paving W. Moreland St.—3rd to 5th Sts.

Ariz., Tucson—Street grading and other impvts. are requested by two-thirds of prop. owners in Rincon Heights and Deputy; also Young East Side Addns., in petitions filed with City Engr. G. N. Atchley. Petitions ask grading east and west streets to roadway width of 50 ft. and north and south streets to 30 ft. Streets included are E. 3rd, 4th, 5th, 6th, 7th and 8th Sts. bet. Cherry and Campbell Aves. and Cherry, Pine, Maple and Campbell Aves. bet. 3rd and 8th Sts.

Cal., Fresno—Resolutions adopted for street work as follows: Lucerne Lane bet. University Ave. and Van Ness Blvd. to be graded and paved with asphalt; alley in blk. 80, to be graded and paved with conc.; Huntington Blvd. bet. Angus and First Sts., to be graded and paved with asphalt; L Street bet. Kern and San Diego Sts. to be graded and paved with asphalt; Ventura Ave. bet. G and P Sts. to be graded and paved with asphalt.

Cal., Huntington Pk.—Resolutions to improve following streets by grading and paving with asphalt concrete and constructing conc. gutters 1 ft. wide, adopted by city trustees: Sections of Stafford, Marconi, Cottage, Regent. Howard McCurdy, Pacific Elec. Bldg., Los Angeles, City Engr.

Cal., La Habra—Chamber of Com. appointed Comn. to take up with Orange Co. Supvrs. matter of forming road imp. dist. to pave roads in La Habra Dist. Est. cost, $105,000.

Cal., Oakdale—City Trustees have agreed on paving program to include one mile on W. Railroad Ave., 2 blks. on 3rd Ave., 2 blks. on E and G Streets, and entire downtown bus. section. Type of pavement not determined. Some prop. owners favor concrete and two trustees favor asphalt.

Colo., Colo. Springs—Practically all funds provided by Federal govt. to state hwy. comn. will be used in reconstr. of highways and bridges torn out by the flood here.

Fla., Bradentown—Manatee Co. Commrs. will arrange to construct rds. in connect. with proposed brdg. over bay from Cortez to Anna Maria Key.

Fla., Pensacola—City will pave 12 blocks including Alcaniz, Davis and other streets.

Ida., Blackfoot—Petition of property owners of ten blks. from business dist. (also residential) for paving with bitulithic, given favorable action and City Atty. instructed to publish city's intention to pave.

Ill., Beardstown—Bd. Pub. Impvts. planning Impvt. Dist. comprising approx. 30 city blocks: 13 on Lafayette, 12 on Monroe, 2 on Main and 3 on 4th Sts.

Ill., Bloomington—Repaving of all streets in business dist. except those thoroughfares where pavements are comparatively new, and placing of all wire service under ground by use of conduit system is plan which city expects to inaugurate in near future. It is planned to pave Main St.—Grove to Chestnut—first. Other streets will be undertaken as rapidly as possible.

Ill., Peoria—Ests. for paving Washington St. with brick—Eaton St. to Chestnut St.—ordered prepared by City Engr. L. Jeffries by Bd. of Local Impvts.; also to prepare ests. for paving Hamilton St. with brick—Adams St. to Water St. Board also passed Ord. for paving Western Ave. with brick blk.—Lincoln Ave. to Martin St.—at est. cost of $22,632.

Ill., Peoria—Bd. Local Impvts. received est. from City Engr. Leonard Jeffries for paving Hanssler Pl. and Bell Ave. from Bigelow St. to Loucks Ave. with brick block. Est. cost for the 5 blocks of paving, $42,952. Bd. Local Impvts. also passed Ord. for paving Pecan St.—S. Adams to S. Washington St.—1 block, with brick block. Est. cost, $5,534. No objections from prop. owners.

Ill., Urbana—City Engr. Lohmann submitted to City Council his est. of cost which he has prepared covering complete construction of proposed impvt. of Church St.—Randolph St. to Russell. Est. cost of proj., $93,728.

Ill., E. St. Louis—State St.—35th to Edgemont—may be paved. Impvt. will cost close to a million dollars. Engrg. Dept. at work on plans and specfs.; impvt. abt. 3½ miles in length.

Ind., Wabash—County Comn. and city officials considering advisability of paving Lafontaine Rd. from Wabash St. to new paving if City would pave Wabash St. as far so. as Wabash street brdg. Impvt. now being considered extends for dist. of abt. 3 miles on Lafontaine Rd.

Kans., Kansas City—Report presented to City Commrs. by Robt. McAlpine, City Engr., on cost of grading, curbing and paving 10th St. Boulevard—Wash. Blvd. to Quindaro Blvd. Impvt. est. at $92,000. Plans call for 48-ft. pavement from Walker to Chelsea Aves. and 30-ft. from Chelsea to Quindaro.

Kans., Leavenworth—Plans & specfs. for about 30 blocks of paving being drawn by H. A. Perkins, City Engr. Pavement will be conc. with asph. surf.

La., Amite—Tangipahoa Parish will sell $325,000 bonds for road construction in Rd. Dist. 1. F. C. Weist, Secy. Police Jury.

La., Monroe—Ouachita Parish will sell $1,600,000 bonds for constr. of 100 miles roads. Jno. M. Breard, Jr., Pres. Police Jury.

La., Shreveport—Ord. authorizing paving on sections of following streets passed to 3rd reading: Wesley, Virginia, Sanford, Topeka, Buena Vista, Catherine, Lee and Stonewall Sts.

BUYERS' GUIDE

Aerial Tramways.
American Steel & Wire Co.

Armor Plates.
Truscon Steel Co.

Asphalt.
Bitoslag Paving Co.
The Barrett Co.
Pioneer Asphalt Co.
Standard Oil Co. (Indiana)
The Texas Co.
Uvalde Asphalt Paving Co.
Warren Asphalt Paving Co., The

Asphalt Filler.
The Barrett Co.
Bitoslag Paving Co.
Standard Oil Co. (Indiana)
The Texas Co.
Warren Bros. Co.

Asphalt Floors.
The Barrett Co.
The Texas Co.
Warren Bros. Co.

Asphalt Machinery.
Cummer & Son Co., The F. D.

Asphalt Plants.
Austin Machinery Corporation.
Cummer & Son Co., The F. D.
Littleford Brothers.
Warren Bros. Co.

Asphalt Railroad Plants.
Cummer & Son Co., The F. D.
Warren Bros. Co.

Asphalt Surface Heaters.
Barber Asphalt Paving Co.

Asphalt Tools.
Littleford Brothers.
Warren Bros. Co.

Asphalt Tool Wagons.
Barber Asphalt Paving Co.
Littleford Brothers.

Auto Fire Apparatus.
Diamond T Motor Car Co.
Duplex Truck Co.
Garford Co., The
Kissel Motor Car Co.
Lewis-Hall Iron Works.
Packard Motor Car Co.
Pierce-Arrow Motor Car Co.

Back Fillers.
Austin Machinery Corporation.
Pawling and Harnischfeger.

Barber Brand Cold Repair Cement.
Barber Asphalt Paving Co.

Bar Cutters and Benders.
Koehring Machine Co.

Bars, Reinforcing.
Truscon Steel Co.

Bermudez Road Asphalt.
Barber Asphalt Paving Co.

Binders, Road.
Barber Asphalt Paving Co.
The Texas Co.
Pioneer Asphalt Co.
Standard Oil Co. (Indiana)
Uvalde Asphalt Paving Co.
Warren Bros. Co.

Bitulithic Pavements.
Warren Bros. Co.

Bodies.
Lee Loader and Body Co.
Littleford Brothers.

Braces, Extension.
Kalamazoo Fdy. & Machine Co.

Brick Rattlers.
Olsen & Co., Tinius.

Brick-Testing Machinery.
Tinius Olsen Testing Mach. Co.

Bridges.
Lewis-Hall Iron Works.

Buckets, Dredging, Excavating and Sewer.
Pawling and Harnischfeger.

Buckets, Dumping.
Littleford Brothers.
Pawling and Harnischfeger.

Cableway Accessories.
Sauerman Bros.

Cableway Excavators.
Sauerman Bros.

Calculators.
Kolesch & Co.

Car Pullers, Electric.
Mead-Morrison Mfg. Co.

Car Unloaders.
Austin Machinery Corporation.
Heltzel Steel Form & Iron Co.

Castings.
American Cast Iron Pipe Co.
U. S. Cast Iron Pipe & Fdy. Co.

Cast Iron Pipe.
American Cast Iron Pipe Co.
U. S. Cast Iron Pipe & Fdy. Co.

Catchbasins.
Dee Co., Wm. E.
Madison Foundry Co.

Cement Testing.
Kirschbraun, Lester.

Cement Testing Machinery.
Tinius Olsen Testing Mach. Co.

Chimneys, Concrete.
Truscon Steel Co.

Chimneys, Steel.
Lewis-Hall Iron Works.
Littleford Brothers.

Chloride of Lime.
Pennsylvania Salt Mfg. Co.

Chutes, Concrete.
Heltzel Steel Form & Iron Co.
Littleford Brothers.

Concrete Mixers.
Austin Machinery Corporation.
Koehring Machine Co.
Smith Co., T. L. The

Concrete, Reinforcement.
American Steel & Wire Co.
Truscon Steel Co.

Conduits.
Cannelton Sewer Pipe Co.
Truscon Steel Co.

Conduit Rods.
Stewart, W. H.

Conduits, Wood, Creosoted.
Republic Creosoting Co.

Consulting Engineers.
Alvord, John W.
Artingstall, Wm.
Brossmann, Chas.
Burd & Giffels.
City Wastes Disposal Co.
Dow & Smith.
Fargo Engineering Co.
Flood, Walter H., & Co.
Greeley, Samuel A.
Hill & Ferguson
Howard, J. W.
Howe & Co., Robert W.
Jones, Sam L.
Kirchoffer, W. G.
Kirschbraun, Lester.
Potter, Alexander.
Shields, W. S.
Van Trump, Isaac.
Wells, James P.

Contractors.
City Wastes Disposal Co.
Sullivan, Long & Hagerty.
Warren Bros. Co.

Contractors' Tools and Machinery.
Austin Machinery Corporation.
Austin-Western Co., Ltd., The
Barber Asphalt Paving Co.
Good Roads Machinery Co., Inc.
Koehring Machine Co.
Littleford Bros.
Smith Co., T. L. The

Contractors' Wagons.
Austin Machinery Corporation.
Austin-Western Co., Ltd., The

Conveying Machinery.
Mead-Morrison Mfg. Co.
Pawling & Harnischfeger.
Portable Machinery Co., Inc.
Webster Mfg. Co.

Cranes and Hoists.
Austin Machinery Corporation.
Heltzel Steel Form & Iron Co.
Pawling and Harnischfeger.

Creosote.
The Barrett Co.
Republic Creosoting Co.

Creosoted Wood Block.
(Factory Floors, Bridge Floors)
Republic Creosoting Co.

Crushers, Rock and Ore.
Austin-Western Road Machinery Co.
Good Roads Machinery Co., Inc.

Crushed Stone.
Cleveland Stone Co., The

Culvert Molds.
Austin-Western Co., Ltd., The

Culvert Pipe, Cast Iron.
American Cast Iron Pipe Co.

Culvert Pipe, Vitrified.
Cannelton Pipe Co.
Dee Clay Mfg. Co., Wm. E.

Culverts.
Newport Culvert Co.
Truscon Steel Co.

Curb and Gutter Forms.
Heltzel Steel Form & Iron Co.
Truscon Steel Co.

Curb Bar.
Truscon Steel Co.

Curbing, Sandstone.
Cleveland Stone Co., The

Direct Oxidation Process.
Direct Oxidation Process Corp.

Drag-Line Excavators.
Austin Machinery Corporation.

Drag Scrapers.
Austin-Western Road Machinery Co.

Drain Tile.
Dee Clay Mfg. Co., W. E.

Dryers.
Cummer & Son Co., The F. D.

Dump Cars.
Austin-Western Road Machinery Co.

Dump Wagons.
Austin-Western Road Machinery Co.

Md., Baltimore—Pub. Impvt. Loan Comm. may expend $300,000 in relocation and impvt. of roads winding abt. rim of greater Lock Raven reservoir. Wm. A. Megraw, Water Engr.

Mo., Alton—Plans being prepared by Oregon Co. for paving with bitum. concrete on conc. base, 8 miles of road; Est. cost, $125,000. Eaton, Axon & Russell, Engrs., Springfield.

Mo., Clinton—Henry County will constr. 14 mi. Joplin-Chat. Rd.; $93,785; also 7.67 mi. dirt road, including conc. brdgs., $34,793. Mr. Parks, Co. Engr. Clinton will constr. 11 blocks cement streets; bids to be advertised soon. G. Hart, City Clk. H. C. Allen, Engr.

Mo., St. Joseph—City expects to ask bids within short time, for paving Frederick Ave. F. Henderson, Purch. Agt. for street railway company, submitted to Bd. of Est. report that paving, including space betw. rails and 18 ins. on either side thereof, would cost company $135,000.

N. Y., Schenectady—Ord. introduced for grading, paving and curbing Dale Place bet. Prospect Street and the sand bank; one course rein. conc., 20 ft. wide and 8 ins. thick at center and 6 ins. thick at curb lines; carriageway will be curbed on both sides with 6-in. conc. steel edged curbs. Bd. of Contract & Supply directed to have plans & specfs. prepared and to let contract for the work.

N. C., Gastonia—Gaston Co. will construct roads; voted $800,000 bonds.

N. C., Hertford—Perquimans Co. will construct 26 miles hwy.; may issue $700,000 bonds.

N. C., Snow Hill—Greene Co. sold $500,000 road constr. bonds.

N. D., Grafton—Petitions circulated for 30 blocks additional paving. H. J. Johnson, City Clk.

Ohio, Akron—City will improve 36 miles of streets.

Ohio, Barberton—Ord. passed by City Council to improve Park Ave. V. H. Lucas, Pres. of Council. Resolution passed to secure funds for purpose of improving North Side of Kenmore Blvd., by paving with brick., conc. base, curbing and guttering. Ord. passed to improve Park Ave.—Bolivar Rd. west to 3rd St. by grading, draining and paving with brick or asph., conc. base, curbing and guttering. Ord. also passed to issue and sell $14,600 bonds for purpose of paying property owners' portion of cost of paving alley bet. Baird and Tuscarawas Aves.

Okla., Bartlesville—Plans for paving E. 7th St. being rushed. Co. Commrs. have agreed to pay for a portion of the impvt.

Okla., Elreno—Paving of alleys in business section of city with concrete may be started in near future. Petition requesting improvement filed with City Commrs.

Okla., Nowata—Nowata Co., Delaware, Lenapah & Capps Precincts to expend $105,000 for hard surf. rd. bet. Delaware and Lenapah.

Ore., Beaverton—Town will asphalt in Front, Lombard and possibly Watson Streets this year. Also macadamize East St. Commercial Club working with Council for impvt. of town.

Pa., Beaver—Ord. passed final reading for paving 6th, 8th and 10th, 11th, 12th, 13th and 15th Sts. from Penn. Ave. to Indiana Ave.; also Virginia Ave.—11th to 15th Sts. and Ind. Ave.—5th to 15th Sts.

Pa., Bedford—State Hwy. Dept., it is reported may improve 100 miles of Lincoln Hwy. betw. this place and Pittsburgh.

Pa., Pittsburgh—Ord. introduced to grade, pave and curb Damas and Winslow streets; also some others. E. V. Babcock, Mayor. Council of Knoxville (Pittsburgh, P. O.) considering repair of 6 streets in Boro.

Pa., Swissvale—Boro. Council has passed 3 Ords., providing for grading, curbing and paving certain streets in Boro.

Tex., Johnson City—U. S. Bureau Pub. Rds., Washington, has approved project statement for proposed constr. of 13.9 miles Hwy. No. 20-A, Blanco Co.; $70,600. Wm. Martin, Co. Judge. Johnson City; W. C. Yeager, Co. Engr., Blanco.

Tex., Austin—State Hwy. Dept. has approved plans for constr. of 3.7 miles 16-ft. gravel rd. on Hwy. 39, Hunt Co.; $101,500. O. P. McWhirter, Co. Judge; A. D. Duck, Co. Engr.

Tex., Ft. Worth—U. S. Dist. Engr. here has approved plans for constr. of 8.7 miles 16-ft. gravel bitum. rd. on Hwy. No. 11; Hunt Co., $225,886. O. P. McWhirter, Co. Judge; A. D. Dach, Co. Engr. (Greenville); plans also approved for constr. of 9.9 miles 15-ft. gravel rd. on Hwy. 2-A, Hill Co., $171,536. (Hillsboro) W. L. Wray, Co. Judge. Dist. Engr., Austin, has approved plans for constr. of 5 mi. 16-ft. conc. rd. on Hwy. No. 3, Orange Co. (Orange); $272,206. E. S. McCarver, Co. Judge; J. E. Johnson, Res. Co. Engr.

Va., Norfolk—City Manager and Council have decided on paving program which includes about 95 streets, more or less.

Wash., Hillyard—Citizens desire paving of 4 blocks on Diamond St.; paving to be done same time that Diamond Ave. is paved from Regal to Market Sts. Petition for last mentioned impvt. filed and will be acted on soon.

SEWERAGE AND SEWAGE TREATMENT.

Cal., Anaheim—$30,000 bonds voted here for sewer extensions.

Cal., Los Angeles—Councilman W. Mallard suggested that City Engr. be instructed to prepare Ord. providing for installing san. sewers in Arroyo Seco Dist. to serve groups of "squatters" in that section of city. Matter being considered by Council.

Cal., Los Angeles—City Council voted to approposal system within city.
flushers to be installed throughout the sewage dis-

Ont., London—City plans to extend sewerage system. Abt. $300,000. H. A. Brazier, City Engr.

Colo., Durango—Ord. passed for constr. of san. sewers in Dist. No. 5, which includes all of lots 17 to 26 inclusive, blk. 57, lots 14 to 26 inclusive in Blk. 47, all lots 14 to 26 inclu. in Blk. 37, 14 to 26 inclu. in Blk. 27, 14 to 26 inclu. in Blk. 17, 14 to 40 in Blk. 7.

Ida., Boise—Effect of surf. water on sewer sys, in So. Boise and plans to correct this matter, taken up by city and state officials. Situation will be temporaily taken care of by surface work, new ditches and culverts and cleaning up but Engr. instructed to work out more detailed draing. plan.

Ill., Bellwood—City having prepared for bldg. 8-42 in. vit. tile san. sewers in various streets. Abt. $167,000. E. A. Rossiter, 127 N. Dearborn Ave., Chicago, Engr.

Ill., Morton—City has had plans prepared for comprehensive sewer system. Plans submitted to St. Dept. Pub. Health for approval. It is contemplated to use sys. for storm draing. only, at present, but to later allow connection of san. sewers.

Ill., Rockford—Two committees appointed by Mayor to secure right-of-way for proposed $1,000,000 trunk line sewer along west bank of Rock River from Auburn street to the dam. Proposed section will be built at cost of $88,000 and will eliminate 8,000,000 gals. of sewage from Rock River. Trunk line for west bank of river is part of proposed system providing for trunk line sewers on both sides of river extending to point below city where sewage disp. plant will be erected. Cost of entire system, $1,000,000. Mr. Harvey, City Engr.

Ill., So. Pekin—City Care—J. Hill, Mayor, plans to construct storm and drain sewers in various streets. Abt. $40,000. Engineer not yet selected.

Ia., Arnolds Park—Town will construct water works and sewer system at cost of $125,000. Sioux City engineers have made complete plans for the impvt.

Iowa, St. Ansgar—Resolution introduced and filed for construction of system of san. sewers, sewage disposal plant, main and lateral sewers. To be considered at meeting of Council July 21st. T. H. Hume, Mayor. C. T. Tollefson, Clk.

Ia., Sioux City—Four new san. sewers authorized by Council. So. Maple St.—Morningside Ave. to Orleans Ave.; So. Cypress St.—Morningside Ave. to Orleans; Sioux St.—W. 7th to W. 8th Sts.—and in S. Prescott—lot 53, Highland Addn. to Riverside Blvd.

Mich., Crystal Falls—City considering construction of sewers in Sewer Dist. comprising Lots 13 to 18 inclusive, 66, 67, 110, 111 and 112 of the J. B. Schwartz 1st addn. to city and lots 189 to 188 inclusive and 273 of 1st addn. Wm. J. Gribble, City Clk.

Minn., Alexandria—Prelim. surveys being made for sewerage system. Abt. $95,000. H. S. Campbell, Clk. C. L. Pillsbury Co., 1200 2nd Ave., S. Minneapolis, Engrs.

Minn., Minneapolis—Resolutions authorizing expendt. of $350,000 for sewer construction will be

BUYERS' GUIDE

Dust Laying Compound.
The Barrett Co.
Standard Oil Co. (Indiana)
The Texas Co.

Edge Protector.
Truscon Steel Co.

Electrical Wires & Cables.
American Steel & Wire Co.

Elevating Graders.
Austin-Western Road Machinery Co.

Elevators.
C. H. & E. Mfg. Co.

Engineering Instruments.
Kolesch & Co.
Lufkin Rule Co., The

Engines.
C. H. & E Mfg. Co.
Midwest Engine Co.

Excavating Machinery.
F. C. Austin Machinery Co.
Pawling and Harnischfeger.
Sauerman Bros.
Smith Co., T. L. The

Expansion Joint Compound.
The Barrett Co.
Pioneer Asphalt Co.
Truscon Steel Co.

Explosives.
E. I. du Pont de Nemours & Co.

Fence, Iron.
Cincinnati Iron Fence Co.

Fillers (Paving Joint).
Barber Asphalt Paving Co.
The Barrett Co.
Pioneer Asphalt Co.
The Texas Co.

Fire Brick.
Cannelton Sewer Pipe Co.
Dee Clay Mfg. Co., W. E.

Flue Liners.
Cannelton Sewer Pipe Co.
Dee Clay Mfg. Co., W. E.

Forms, Sidewalks, Curb & Gutter.
Heltzel Steel Form & Iron Co.
Truscon Steel Co.

Forms, Road.
Heltzel Steel Form & Iron Co.
Truscon Steel Co.

Forms (Sewers & Conduits).
Heltzel Steel Form & Iron Co.

Forms (Wall Bldg., Construction, Etc.).
Heltzel Steel Form & Iron Co.

Gas Pipe.
American Cast Iron Pipe Co.
U. S. Cast Iron Pipe & Fdy. Co.

Graders.
Austin-Western Road Machinery Co.
Good Roads Machinery Co., Inc.

Granite Block.
Granite Paving Block Mfrs. Assn. of the U. S., Inc.

Gravel Screener and Loader.
Good Roads Machinery Co., Inc.
Jordan & Steele Mfg. Co., Inc.

Heaters (Rock and Sand).
Littleford Bros.

Heating Wagons (Oil and Tar).
Good Roads Machinery Co., Inc.
Littleford Bros.

Hoists (Concrete, Gasoline and Hand).
Pawling and Harnischfeger.

Hoists, Electric.
Mead-Morrison Mfg. Co.
Pawling and Harnischfeger.

Hoists, Steam.
C. H. & E. Mfg. Co.
Lewis-Hall Iron Works.
Mead-Morrison Mfg. Co.

Hot Mixers.
F. C. Austin Machinery Co.
Barber Asphalt Paving Co.

Hydrants.
The Flower Company.

Inlets (Sewer).
Dee Co., Wm. E.
Madison Foundry Co.

Insulating Material.
The Barrett Co.
Pioneer Asphalt Co.

Joint Fillers (Paving).
The Barrett Co.
The Texas Company.

Kettles (Portable).
Barber Asphalt Paving Co.
Cummer & Son Co., The F. D.
Good Roads Machinery Co., Inc.
Littleford Brothers.

Loaders.
Brown Portable Conveying Machine Co.

Manhole Covers.
Madison Foundry Co.
Dee Co., Wm. E.

Mastic.
Pioneer Asphalt Co.

Meter Boxes.
McNutt Meter Box Co.

Mixers, Asphalt.
Austin Machinery Corporation.
Barber Asphalt Paving Co.
Cummer & Sons Co., The F. D.

Mixers, Concrete.
Austin Machinery Corporation.
Koehring Machine Company.
T. L. Smith Co.

Mixers—Mortar.
C. H. & E. Mfg. Co.

Molds (Pipe & Culvert).
Heltzel Steel Form & Iron Co.

Motor Fire Apparatus.
Acme Motor Truck Co.
Diamond T Motor Car Co.
Duplex Truck Co.
Federal Motor Truck Co.
Garford Motor Truck Co.
Kissel Motor Car Co.
Lewis-Hall Iron Works.
Packard Motor Car Co.
Pierce-Arrow Motor Car Co.

Motor Trucks.
Acme Motor Truck Co.
Duplex Truck Co.
Diamond T Motor Car Co.
Federal Motor Truck Co.
Kissel Motor Car Co.
Lewis-Hall Iron Works.
Packard Motor Car Co.
Pierce-Arrow Motor Car Co.

Motor Truck Flushers, Sprinklers and Oilers.
Acme Motor Truck Co.
Austin Machinery Corporation.
Diamond T Motor Car Co.
Duplex Truck Co.
Federal Motor Truck Co.
Garford Motor Truck Co., The
The Gramm-Bernstein Motor Truck Co.
Kissel Motor Car Co.
Lewis-Hall Iron Works.
Packard Motor Car Co.
Pierce-Arrow Motor Car Co.

Municipal Castings.
Dee Co., Wm. E.
Madison Foundry.

Packing.
Pioneer Asphalt Co.

Paints (Asphalt).
Barber Asphalt Paving Co.
Barrett Co., The
Pioneer Asphalt Co.

Paving Blocks (Creosoted).
The Barrett Co.
Republic Creosoting Co.

Paving Brick.
Medal Paving Brick Co.
Metropolitan Paving Brick Co.
Murphysboro Paving Brick Co.
National Paving Brick Mfrs. Assn.
Springfield Paving Brick Co.

Paving Contractors.
Warren Bros Co.

Paving Joint Compound.
Barber Asphalt Paving Co.
The Barrett Co.
Pioneer Asphalt Co.
The Texas Company.

Paving Joint Filler.
Barber Asphalt Paving Co.
The Barrett Co.
Pioneer Asphalt Co.
The Texas Company.

Paving Machines.
Austin Machinery Corporation.
Cummer & Son Co., The F. D.
East Iron & Machine Co., The
Warren Bros. Co.

Paving Plants (Asphalt).
Austin Machinery Corporation.
Barber Asphalt Paving Co.
Cummer & Son Co., The F. D.
East Iron & Machine Co., The
Good Roads Machinery Co., Inc.
Smith Co., T. L. The
Warren Bros. Co.

Pipe Cutters.
W. W. Strickler & Bro.

Pipe Dip and Coatings.
The Barrett Co.
Pioneer Asphalt Co.
The Texas Co.

Pipe Manufacturers.
American Cast Iron Pipe Co.
U. S. Cast Iron Pipe & Fdy. Co.

Pitch Filler.
The Barrett Co.
Warren Bros. Co.

Plows (Rooter and Wing).
Austin-Western Road Cach. Co.

Portable Paving Plants.
Austin Machinery Corporation.
Cummer & Son Co., The F. D.
East Iron & Machine Co., The
Good Roads Machinery Co., Inc.
Littleford Brothers.
Warren Bros. Co.

Portable Stone Bins.
Austin-Western Road Machinery Co.
Good Roads Machinery Co., Inc.

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presented to City Council with favorable recommendations from Sewer Comm., which apportioned proceeds of recent sale of $350,000 sewer bonds.

Minn., New Prague—Toltz, King & Day, 1410 Pioneer Bldg., St. Paul, Engrs. & Archts., finishing plans for sewer system, including sewage disposal plant. J. F. Brusek, City Clk.

N. H., Nashua—Dept. Pub. Wks. plans to construct vitr. sewers in various streets. Abt. $50,000.

N. C., Durham—City contemplates installing 2 mile sewer system. City Engr. Kueffner.

Ohio, Ashtabula—City contemplates constr. of sewage disp. plant. Abt. $500,000. C. R. Stanhope, City Engr.

Ohio, Canton—Ord. passed authorizing issuance of $35,000 bonds for purpose of completing constr. of intercepting san. trunk sewer in eastern portion of city from 5th St. S. E. to 6th St. N. E.

Okla., Healdton—$50,000 bonds voted to install sewer system.

Okla., McAlester—City (E. M. Fry, Mgr.) will expend $50,000 to construct sewage disp. plant, Imhoff tank and sprinkler filters for $20,000 population plans expending $50,000 for future extension. Ben-Ham & Mullergren, Cons. Engrs., Firestone Bldg., Kans. City, Mo.

Okla., Temple—City has issued $65,000 sewer and water bonds.

S. C., Andrews—City—S. P. Harper, Commr. Pub. Wks.—will construct $100,000 sewer system.

Tenn., Knoxville—$75,000 bonds will be issued to construct sewer system in So. Knoxville.

Tex., Dallas—Citizens of Bonview Addn. have launched drive for san. sewerage system and have filed petition containing long list of names with Commr. Apol, who has taken matter up with city engrg. dept.

Wash., Yakima—Dr. Paul Turner, Direct. State Health Dept., has made demand on City Comn. that construction begin immediately of sewage disp. plant.

W. Va., Spencer—Town (S. P. Bell, Mayor) voted $40,000 bonds to construct san. sewer system.

WATER SUPPLY AND PURIFIFCATION.

Cal., Anaheim—$50,000 bond issue for extens. to water sys. carried at special election.

Cal., Lompoc—City trustees have decided to lay new water mains on north and south sides of town.

Cal., Madera—$41,000 bond issue for extension of water system carried at special election.

Cal., Marysville—Olmstead & Gillelen. Cons. Engrs., Los Angeles, retained by Council to make survey and report plans and ests. for municipal water system.

Ont., Chatham—Bd. of Health has recommended constr. of chlorinating basin of half a million gals. capy. C. H. R. Fuller, City Engr.

Que., Hull—City will soon ask bids for bldg. new water mains in several streets. Abt. $50,000. T. Lanctot, City Hall, Engr.

Ont., Milbury—Town plans to install 4 two-stage centrif. pumps, gasoline driven, 300 Imperial gal.-per-min. capy. and possibly one 800 Imperial gal. elec. pump, all for 80 to 100 lbs. fire pressure. Est. cost abt. **$30,000.**

B. C., Saanich—Council has recommended placing of by-law before taxpayers for raising $100,000 to be used for water extensions.

Que., St. Hyacinthe—Grand Trunk Ry. Co. has applied for permission to lay pipe line to bring water from the Yamaska River to Grand Trunk station here.

D. C., Washington—Army appropriation bill includes $200,000 to begin work on new conduit for conveyance of water from Great Falls on Potomac River to Washington. Total est. cost of new conduit, $9,000,000.

Ill., Bellwood—It is proposed to construct new water works system at cost of $167,000.

Ill., Chicago—Appropriation of $450,000 approved for work on Western Ave. water tunnel which is to lead from Wm. Hale Thompson Pumping Sta. Jerseyville, Ill. Town contemplates laying 6 and 8 inch water mains and constructing pumping sta. and reservoir. Abt. $75 000. Fuller & Beard, Chem. Bldg., St. Louis, Mo., Engrs.

Ill., Springfield—Following work authorized by City Council and Acting Mayor J. Emil Smith authorized to ask for contr. bids: 6-in. water service pipe in Walnut Street—Conkling Ave. to Laurel St., $3,289; 6-in. water serv. pipe in 14th St.—Ash St. to Cornell Ave., $3,165; 6-in. in 13th St.—Lenox Ave. to 346 ft. so., $1,248; 6-in. in 12th St.—Ash St. to Lenox Ave., $4,147. Ords. also passed on 1st reading specifying 6-in. water main in [illegible] St.—Walnut to Reisch St., $3,972.

Ia., Arnolds Park—Town considering expendt. of $125,000 for constr. of water works and sewer system. Bids will be advertised soon.

Ky., Paintsville—City will install 350,000-gal. filter plant, conc. reservoir and water works. M. B. Westcott, Supvg. Engr.

Minn., Duluth—Petition submitted to Council asking for exten. of water and gas mains to Morningside Park. P. G. Phillips, Commr. Pub. Utilities. City Commrs. considering enlarging Endion reservoir from 3,500,000 gal. capy. to 6,500,000 gal. and covering same; also to construct new reservoir in Cascade Park, 30,000,000-gal. capy. Est. cost of Endion reservoir, $100,000; Cascade, $300,000.

N. J., Gloucester—Plans submitted to Bd. of Directors, Chamber of Commerce by Engrs. Remington & Vosbury for new pumping station at water works. Est. cost new plant, $175,000. It is planned to erect new bldgs., new standpipe, new filtr. plant and to electrify plant.

N. C., Clinton—Town has issued $50,000 water, sewer and street bonds. H. A. James, Clk.-Treas.

Okla., Bartlesville—Bd. Co. Commrs. Wash. Co. considering installing water purifier and softener. Neva M. Scott, Co. Clk.

Okla., Broken Bow—City having plans prepared for pumping station, reservoir and water mains. About $120,000. Black & Veatch, Mutual Bldg., Kans. City, Mo., Engrs.

Okla., Cordell—City contemplates constr. of flood water dam and bypass with filtr. plant for city's reservoir.

Okla., Hugo—Chamber of Com. interested in bldg. 150,000 h. p. hydro-elec. plant on Mountain Fork; 100,000 h. p. plant on Little River and 50,000 h. p. plant on Kiamichi River.

Okla., Temple—$65,000 water works and sewer bonds voted.

Pa., Harrisburg—Pub. Serv. Comm. has made order on Port Vue Water Co. against which concern Boro. of Pt. Vue brought complaint regarding water supply, directing company to make installations, changes and impvts. to system. Est. cost of impvts., $28,000. Comm. has ordered that impvts. be made immediately. Order directs that pumping sta. be removed from present location and that 1 additional gas eng. driven pump, capy. 50 gals. a minute, be installed; eng. to make required number of gals. a min. against head of 300 ft. and be installed as a stand-by. At site of existing conc. tank company is ordered to erect a 75,000-gal. steel tank on 65-ft. tower; also lay 6-in. pipe line across 15th St. brdg. from discharge line of McKeesport pumps to Borough's 6-in. line; also lay 6-in. line in Brushton St.—from 6-in. line in Tacoma Ave. to 4-in. line in Meyer Ave.; also additional 6-in. line from tank to be connected with the 4-in. line in Edmunds Ave.; also remove regulating valve in Realty Ave. and install gate valve in 6-in. line in Tacoma Ave.

Pa., Phila.—City considering laying 32,000 lin. ft. 6036 in. c. i. water mains in various streets. Above part of $2,000,000 proj. F. Caven, City Hall, Engr.

Pa., Pittsburgh—City must expend approx. $350,000 to repair Highland Pk. Reservoir No. 2. E. E. Lanpher, Div. Engr. of Bureau of Water. Reservoir is 14,000 ft. in circumference and is an average depth of 30 ft.

S. C., Andrews—City (S. P. Harper, Comm. Pub. Wks.) will expend $150,000 to construct $450,000-gal. plant; install electrically propelled centrif. pumps; construct 1,000,000-gal. capy. raw water reservoir; 500,000-gal. capy. settling basin; 500,000-gal. capy. clear water reservoir.

Va., St. Paul—City will ask bids in near future on following work: Constructing 150,000-gal. capy. plant at cost of $45,000; erection of 20x18 ft. brk. filtr. house; installing $5,000 pumps and filtr. plant machy.; erecting 150,000-gal. capacity rein. conc. reservoir. W. A. Bennett, Engr., Rocky Mt., Va.

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Pioneer Asphalt Co.
Standard Oil Co. (Indiana)
The Texas Co.
Uvalde Asphalt Paving Co.
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Road Graders.
Austin-Western Road Machinery Co., The
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Road Machinery.
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Austin-Western Road Machinery Co., The
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Cummer & Son Co., The F. D.
Good Roads Machinery Co., Inc.
Littleford Brothers.
Midwest Engine Co.
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Road Planer.
Austin-Western Road Machinery Co., The

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Rock Crushers.
Austin-Western Road Machinery Co., The
Good Roads Machinery Co., Inc.

Roofing Material.
Barber Asphalt Paving Co.
The Barrett Co.
Pioneer Asphalt Co.
The Texas Co.
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Sand Dryers.
Cummer & Son Co., The F. D.
Littleford Brothers.

Saw Rigs.
C. H. & E. Mfg. Co.

Sandstone.
Cleveland Stone Co.

Scarifiers.
Austin-Western Road Machinery Co., The
Good Roads Machinery Co., Inc.

Scrapers, Drag Line.
Pawling and Harnishchfeger.
Sauerman Bros.

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Austin-Western Road Machinery Co., The
Good Roads Machinery Co., Inc.

Scrapers, Power.
Sauerman Bros.

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Direct Oxidation Process Corp.

Sewer Braces.
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Madison Foundry Co.

Sewer Cleaning Machinery.
Stewart, W. H.

Sewer Forms.
Heltzel Steel Form & Iron Co.

Sewer Pipe.
Cannelton Sewer Pipe Co.
Dee Clay Mfg. Co., W. E.

Sewer Rods.
Stewart, W. H.

Sidewalks (Stone).
Cleveland Stone Co.

Sluice Gates.
Coldwell-Wilcox Co.

Snow Removal Machinery.
Austin Machinery Corporation.
Good Roads Machinery Co., Inc.

Special Castings.
The Flower Company.
U. S. Cast Iron Pipe & Fdy. Co.

Sprinklers.
Austin Machinery Corporation.
Austin-Western Road Machinery Co., The

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Truscon Steel Co.

Steel Tapes.
Kolesch & Co.
Lufkin Rule Co., The

Stone Crushers.
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Street Sprinklers (Horse Drawn).
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Structural Steel.
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Kolesch & Co.
Lufkin Rule Co., The

Sweepers.
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Pennsylvania Salt Mfg. Co.

Water Softener.
The Refinite Co.

Water Works Supplies and Equipment.
American Cast Iron Pipe Co.
Coldwell-Wilcox Co.
The Flower Company.
Mueller Mfg. Co.
Pennsylvania Salt Mfg. Co.

Wheeled Scrapers.
Austin-Western Road Machinery Co.

Wire Rope.
American Steel & Wire Co.

Windows (Steel).
Truscon Steel Co.

Wire-Cut Lug Brick.
Medal Paving Brick Co.
Metropolitan Paving Brick Co.
Murphysboro Paving Brick Co.
Springfield Paving Brick Co.

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